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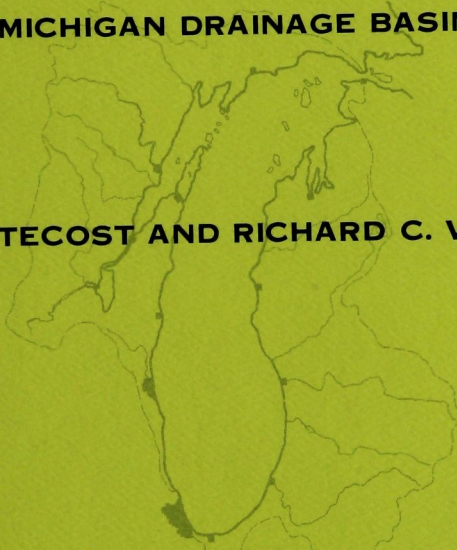


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ENVIRONMENTAL STATUS OF THE LAKE MICHIGAN REGION

**VOLUME 16. AMPHIBIANS AND REPTILES
OF THE LAKE MICHIGAN DRAINAGE BASIN**

EDWIN D. PENTECOST AND RICHARD C. VOGT



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ENVIRONMENTAL STATUS OF
THE LAKE MICHIGAN REGION

Volume 16. Amphibians and Reptiles of the
Lake Michigan Drainage Basin

by

Edwin D. Pentecost and Richard C. Vogt*

Division of Environmental Impact Studies

July 1976

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PREFACE

Assessments of the environmental impacts of individual nuclear power plants sited on the shores of Lake Michigan have led to increased recognition of the need for regional considerations of the environmental impacts of various human activities, and a compendium of information on the environmental status of the region for use in assessing such impacts. In response to these needs, a report series describing the status of Lake Michigan and its watershed is in preparation. This series is entitled "Environmental Status of the Lake Michigan Region"; this report is part of that series.

The report series provides a reasonably comprehensive descriptive review and analysis of natural features and characteristics, as well as past, present, and proposed natural processes and human activities that influence the environmental conditions of Lake Michigan, its watershed, and certain adjacent metropolitan areas. This series will constitute a regional reference document useful both to scientific investigators and to other persons involved in environmental protection, resource planning, and management. In these regards, the "Environmental Status of the Lake Michigan Region" will serve in part as an adjunct to reports of broader scope, such as the Great Lakes Basin Commission's Framework Study.

Other Volumes Published to Date in this Series

Vol. 2. *Physical Limnology of Lake Michigan. Part 1. Physical Characteristics of Lake Michigan and Its Responses to Applied Forces.*

Clifford H. Mortimer. *Part 2. Diffusion and Dispersion.* Gabriel T. Csanady. 1975. 121 pp. NTIS-\$5.45.

Vol. 3. *Chemistry of Lake Michigan.* Marguerite S. Torrey. 1976. 418 pp. NTIS-\$11.00.

Vol. 7. *Earthquake History and Measurement with Application to the Lake Michigan Drainage Basin.* Richard B. Keener. 1974. 19 pp. NTIS-\$4.00.

Vol. 9. *Soils of the Lake Michigan Drainage Basin--An Overview.* Forest Stearns, Francis D. Hole, and Jeffrey Klopatek. 1974. 22 pp. NTIS-\$4.00.

Vol. 10. *Vegetation of the Lake Michigan Drainage Basin.* Forest Stearns and Nicholas Kobriger. 1975. 113 pp. NTIS-\$5.45.

Vol. 15. *Mammals of the Lake Michigan Drainage Basin.* Charles A. Long. 1974. 109 pp. NTIS-\$5.45.

assessment of the environmental effects of the proposed project on the shore of Lake Michigan and the adjacent waters of the Great Lakes. The assessment includes a description of the project, a description of the environment, a description of the project's potential effects on the environment, and a description of the project's potential effects on the Great Lakes. The assessment is based on the best available information and is intended to provide a basis for decision-making by the appropriate authorities.

The report also provides a description of the project's potential effects on the environment, including a description of the project's potential effects on the Great Lakes, the project's potential effects on the surrounding waters, and the project's potential effects on the surrounding land. The report also provides a description of the project's potential effects on the Great Lakes, including a description of the project's potential effects on the Great Lakes' water quality, the project's potential effects on the Great Lakes' fish and wildlife resources, and the project's potential effects on the Great Lakes' cultural and recreational resources. The report also provides a description of the project's potential effects on the surrounding waters, including a description of the project's potential effects on the surrounding waters' water quality, the project's potential effects on the surrounding waters' fish and wildlife resources, and the project's potential effects on the surrounding waters' cultural and recreational resources. The report also provides a description of the project's potential effects on the surrounding land, including a description of the project's potential effects on the surrounding land's water quality, the project's potential effects on the surrounding land's fish and wildlife resources, and the project's potential effects on the surrounding land's cultural and recreational resources.

Other Relevant Publications in this section

- Vol. 1. Physical Assessment of Lake Michigan, Part 1: Physical Characteristics of Lake Michigan and the Surrounding Waters, by Clifford E. Mortimer, Part 2: Biological and Chemical Characteristics of Lake Michigan, by Clifford E. Mortimer, 1975, 11 pp. NTIS-81-00.
- Vol. 2. Chemical Assessment of Lake Michigan, by Clifford E. Mortimer, 1975, 11 pp. NTIS-81-00.
- Vol. 3. Biological Assessment of Lake Michigan, by Clifford E. Mortimer, 1975, 11 pp. NTIS-81-00.
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- Vol. 6. Assessment of the Lake Michigan Cultural and Recreational Resources, by Clifford E. Mortimer, 1975, 11 pp. NTIS-81-00.
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- Vol. 9. Assessment of the Lake Michigan Cultural and Recreational Resources, by Clifford E. Mortimer, 1975, 11 pp. NTIS-81-00.
- Vol. 10. Assessment of the Lake Michigan Water Quality, by Clifford E. Mortimer, 1975, 11 pp. NTIS-81-00.
- Vol. 11. Assessment of the Lake Michigan Fish and Wildlife Resources, by Clifford E. Mortimer, 1975, 11 pp. NTIS-81-00.
- Vol. 12. Assessment of the Lake Michigan Cultural and Recreational Resources, by Clifford E. Mortimer, 1975, 11 pp. NTIS-81-00.

ENVIRONMENTAL STATUS OF THE LAKE MICHIGAN REGION

VOL. 16. AMPHIBIANS AND REPTILES OF THE LAKE MICHIGAN DRAINAGE BASIN

by

Edwin D. Pentecost and Richard C. Vogt

Abstract

The focus of this report is on regional distribution of the herpetofauna of the Lake Michigan Drainage Basin. The introduction includes a brief discussion of plant communities and their associated herpetofauna, and the importance of hibernacula and migration routes. Some aspects of the status, distribution, habitat, and life history of the amphibians and reptiles of the Basin are described in an annotated checklist. Special attention is given to uncommon and endangered species. Species range is shown on distribution maps.

INTRODUCTION

An analysis of the environmental impacts associated with mankind's increasing use of natural resources in the Lake Michigan Drainage Basin is contingent upon some understanding of existing biotic communities and their physical environments. This report provides information on the distributional patterns and habitat requirements for all amphibian and reptile species presently inhabiting the Basin. In general, this account has dispensed with taxonomic information, assuming that the reader will consult an appropriate reference for field identification purposes. The scientific and common names used in this report follow Conant (1975). The ecological information presented focuses primarily on the life histories, economic importance, and trophic relationships of amphibians and reptiles within the Basin.

The herpetological literature utilized in the preparation of this report has consisted mostly of the work of Conant (1975), Minton (1972), Smith (1961), and Vogt (1976--unpublished). In general, these accounts include both life history and ecological information. Conant (1975) presented basic information essential for field identification of amphibians and reptiles of eastern North America; however, his distribution maps and habitat data often are much too general for a region such as the Lake Michigan Drainage Basin. Minton (1972) and Smith (1961) have furnished exceptionally thorough accounts of taxonomic and ecological features of the herpetofauna (amphibians and reptiles) of Indiana and Illinois, respectively. Vogt (1976--unpublished) has provided ecological and life history data for the Wisconsin herpetofauna.

Earlier herpetological literature also was examined. Ruthven *et al.* (1928) published an excellent description and life history account of the herpetofauna of Michigan. Dickinson (1949) presented taxonomic descriptions and distributional data for the lizards and snakes of Wisconsin; however, the distributional data were incomplete and based on old or questionable records. In a later publication, Dickinson (1965) included a taxonomic key, early information on species ranges, and very limited life history data for the amphibians and turtles of Wisconsin. As with the work on lizards and snakes, the life history information was incomplete and the range maps were inaccurate and therefore not representative of current distribution patterns.

In addition to the above references, data from the authors' field experiences and various museum records were utilized to prepare the Annotated Checklist of Amphibians and Reptiles of the Lake Michigan Basin (Annotated Checklist). Museum records were examined from the American Museum of Natural History, Harvard Museum of Comparative Zoology, Michigan Museum of Zoology, Milwaukee Public Museum, Illinois Natural History Survey, University of Wisconsin--Stevens Point Museum of Natural History, U. S. National Museum, Field (Chicago) Museum of Natural History, University of Illinois Museum of Natural History, and University of Wisconsin--Madison Zoological Museum. Most of the Wisconsin specimens in these museums were examined by the junior author during the last three years. Additional distribution records from The Museum at Michigan State University were contributed by Dr. M. M. Hensley.

There is an inherent problem when museum records are used to represent the current ranges of vertebrate species. Historical museum records may not accurately depict a species range, especially if habitat destruction has occurred from land-use changes. Although distribution maps for Michigan amphibians and reptiles are based largely on museum records, personal communication with Michigan herpetologists indicates that these records do reasonably depict present-day ranges. Wisconsin data are based on old museum records as well as recent collections made throughout the state by the junior author. Most of these specimens collected from 1971-1975 are catalogued or in the process of being catalogued at the University of Wisconsin--Madison Zoological Museum and the Milwaukee Public Museum. In the case of the Wisconsin material, recent collections reflect the effects of urbanization, intense agricultural land use, and forestry practices on distribution of the herpetofauna. Undoubtedly some areas of the Basin, such as the Chicago lakefront, Milwaukee County (Wisconsin), and Lake County (Indiana), have become so heavily populated and industrialized that old museum records no longer represent localities presently inhabited by the herpetofauna.

SENSITIVITY OF HERPETOFAUNA TO ENVIRONMENTAL DISTURBANCES

Information on the ecological requirements of many amphibians and reptiles is sufficient to assess their general degree of sensitivity to environmental disturbances. The spotted salamander, red-backed salamander, four-toed salamander, wood frog, pickerel frog, cricket frog, wood turtle, and queen snake are very sensitive, being the first species to disappear with a reduction of dissolved oxygen in the water, forest cutting, urbanization, intense agriculture, or pesticide use (Minton, 1972). Other species such as Butler's garter snake, eastern garter snake, brown snake, painted turtle, snapping turtle, American toad, and chorus frog seem to survive in the center of cities (Butler's garter snake and the brown snake in Milwaukee; the American toad and chorus

frog in Madison). The painted and snapping turtles are also tolerant of polluted waters, inhabiting the most fetid waters of the Rock, Fox, and Milwaukee rivers in Wisconsin.

A detailed knowledge of the life histories of amphibians and reptiles is needed to fully comprehend and assess the severity of environmental alterations on existing populations. For example, to the casual observer, protection of the breeding ponds of wood frogs and spotted salamanders may appear more important to their survival than is the presence of forest canopy adjacent to the ponds. However, from a study of the life histories of these species, it becomes apparent that both require a moist forest floor for foraging and cover once they have metamorphosed and left the breeding ponds. Removal of the forest canopy would allow greater light penetration and create a more xeric condition on the forest floor, consequently altering and eliminating some moist terrain and subterranean habitat. The availability of a water body is not sufficient for the establishment and longevity of turtle populations unless nesting habitat is protected. Activities such as stream dredging and channelization alter streamflow patterns and may reduce shoreline nesting habitat. Although snakes seem rather nomadic, they in fact use specific denning sites for hibernation year after year; with the destruction of denning areas, entire species populations may be lost regardless of maintenance of suitable foraging habitat.

IMPORTANCE OF HIBERNATION SITES (HIBERNACULA)

Many species of snakes hibernate communally in large numbers in a variety of localities. The authors found approximately 200 fox snakes hibernating in an abandoned well in Portage County, Wisconsin. Gillingham (1974) also reported finding fox snakes hibernating in a well in Columbia County, Wisconsin. Eastern garter snakes, brown snakes, and northern red-bellied snakes often hibernate communally in house foundations and rock fissures. Gregory (1974) and Noble and Clausen (1936) discovered hibernating aggregations of eastern garter snakes and brown snakes, respectively, in ant hills.

Several aquatic turtle species hibernate communally in large numbers around springs, inlets to lakes, or river channels. Large hibernating groups of painted turtles, snapping turtles, and map turtles in Wisconsin (Vogt, 1976--unpublished) and stinkpots in Indiana (Minton, 1972) have been found in these habitats.

In like manner, large numbers of northern leopard frogs are known to hibernate in large groups in springs, streams, and lakes. Individuals do not bury themselves in mud but congregate behind logs and rocks in areas of continual water flow. It is during this time that biological supply house collectors reap their largest harvests. Blanchard (1933b) reported large communal hibernating aggregations of four-toed salamanders, spring peepers, chorus frogs, and wood frogs under leaf litter in Livingston County, Michigan, in early November. Carpenter (1952) found aggregations of hibernating snakes (eastern garter snakes, northern ribbon snakes, Butler's garter snakes, northern water snakes, smooth green snakes, brown snakes) and small numbers of amphibians (American toads, western chorus frogs, and blue-spotted salamanders) in an ant mound in Washtenaw County, Michigan.

It is important to protect not only the hibernation and summer foraging sites but also the migration routes between these sites. Northern leopard

frogs migrate in great numbers from hibernacula in deep, moving water to small breeding ponds, then to sedge meadows or wet mesic prairies for summer foraging. Ritchoff (1975) documented extensive mortality of leopard frogs during migration. His data show that a four-lane highway can act as a barrier to migration. Extensive migrations to breeding ponds by tiger salamanders and spotted salamanders occur over fixed paths to the same pond each year (Shoop, 1965; Whitford and Vinegar, 1966).

Some snakes are known to use celestial orientation (Landreth, 1973) to return annually to the same hibernating sites along fixed routes. Migration pathways of turtles to communal nesting grounds also must be considered vital to the species survival. Painted turtles, snapping turtles, and Blanding's turtles often move several hundred meters from water to lay eggs.

The maintenance of hibernacula, migration corridors, and nesting sites are as essential to the maintenance of an amphibian or reptilian species as is the protection of foraging habitat. Elimination of habitat serving these functions would be enough to spatially or temporally limit the species.

VEGETATION TYPES AND ASSOCIATED HERPETOFAUNA

Vegetation of the Lake Michigan Drainage Basin is discussed in Volume 10 of this series by Stearns and Kobriger (1975); the following section uses their classification of native plant communities. Unreferenced description of vegetation associated with some species in the Annotated Checklist of this volume reflects the authors' field experience. Curtis (1959), in his classic work *Vegetation of Wisconsin*, described the natural plant communities of Wisconsin; although much disturbance of native communities has taken place due to agricultural and forestry practices, fires, floods, and urbanization, his use of indicator species and importance values for these species to characterize a plant community is still appropriate. Habitat descriptions in the Annotated Checklist utilize the nomenclature of Stearns and Kobriger (1975). Plant communities are not discrete entities, but are a continuum grading from one type to another, depending on moisture, soil, slope, and other environmental gradients. In a similar fashion, most herpetofaunal communities cannot be discretely partitioned. Many ubiquitous species can be found throughout the vegetation continuum (e.g. American toad, eastern garter snake) while others are very specific in their habitat requirements (e.g. four-toed salamander, red-backed salamander, queen snake).

The following overview of natural plant communities and the characteristic reptiles and amphibians associated with them acknowledges widespread alteration of habitat and restricted distribution of certain communities within the Basin. This paper focuses primarily on "natural" communities and not on agricultural and urban lands.

The Basin may be divided into two floristic provinces which are separated by a narrow zone (the tension zone) containing affinities to both provinces (Curtis, 1959; Stearns and Kobriger, 1975; Veatch, 1932). Boreal elements occur north and prairie elements south of this zone (Curtis, 1959). Stearns and Kobriger (1975) have illustrated the distribution of these vegetative community types within the Basin.

BOREAL (SPRUCE-FIR) FOREST

Boreal forests are characterized by white spruce (*Picea glauca*) and balsam fir (*Abies balsamea*) as dominant tree species. White pine, white cedar, white birch, sugar maple, trembling aspen, and hemlock also are major components (Maycock and Curtis, 1960). Amphibians and reptiles commonly encountered in the boreal forest within the Basin are the red-backed salamander, mink frog, wood frog, and northern red-bellied snake.

NORTHERN LOWLAND (SWAMP CONIFER) FOREST

Black spruce (*Picea mariana*) and tamarack (*Larix laricina*) are dominant in northern wet forest, and white cedar (*Thuja occidentalis*), balsam fir (*Abies balsamea*), and black ash (*Fraxinus nigra*) are dominant in the northern wet-mesic forest. These forests have a characteristic peaty substrate. The northern wet forest is associated with sphagnum bogs which provide habitat for the mink frog and the northern ribbon snake. In addition, the eastern garter snake, painted turtle, northern red-bellied snake, central newt, and green frog are present. Wet-mesic forests have a diverse and dense ground layer, offering cover to such species as red-backed salamander, spotted salamander, northern red-bellied snake, wood frog, eastern gray treefrog, and northern spring peeper.

NORTHERN MESIC (NORTHERN HARDWOOD OR HARDWOOD HEMLOCK) FOREST

Northern mesic hardwoods are characterized by sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), hemlock (*Tsuga canadensis*), or yellow birch (*Betula lutea*); these species comprise over 90% of the canopy. The understory is very sparse or totally lacking, accounting for a paucity of reptilian and amphibian species in pure hardwood forests. The red-backed salamander, spotted salamander, wood frog, and northern ringneck snake are representative species.

NORTHERN XERIC (PINE) FOREST

Northern xeric forests have jack pine (*Pinus banksiana*), red pine (*P. resinosa*), white pine (*P. strobus*), Hill's oak (*Quercus ellipsoidalis*), or red oak (*Q. rubra*) as dominant species on upland sites. The five-lined skink, blue-spotted salamander, and western fox snake are common in these forests.

PINE BARRENS

Pine barrens are characterized by jack pine (*Pinus banksiana*) with Hill's (*Quercus ellipsoidalis*) or black oak (*Q. velutina*) in scattered clumps interspersed in areas of sedges, grasses, forbs, and shrubs. Primarily the pine barrens occur on sandy soils north of the tension zone. The five-lined skink, eastern hognose snake, northern ringneck snake, smooth green snake, bullsnake, southern gray treefrog, and American toad are representative of pine barrens.

OAK SAVANNA OR OAK OPENINGS

These forest types occur primarily south of the tension zone and are characterized by black oak (*Quercus velutina*), red oak (*Q. rubra*), bur oak (*Q. macrocarpa*), or white oak (*Q. alba*). Like the pine barrens of the north, the oak savannas or oak openings are characterized by occasional trees scattered

throughout grasses, sedges, and low shrubs that grow on a sandy soil. The western slender glass lizard, five-lined skink, blue racer, eastern milk snake, eastern hognose snake, bullsnake, eastern tiger salamander, American toad, and southern gray treefrog are indigenous to these areas.

SEDGE MEADOW (LOWLAND)

Northern sedge meadows are dominated by bulrushes (*Scirpus* spp.), while southern sedge meadows are dominated by sedges (*Carex* spp.) (Curtis, 1959). Sedge meadows are wet lowlands often grading into the wet marshes of cattails and reeds on one end and shrub-carr, alder thicket, or lowland forest on the other (Stearns and Kobriger, 1975). The western chorus frog, eastern garter snake, smooth green snake, northern leopard frog, and Blanding's turtle are common residents of these areas.

SOUTHERN LOWLAND (HARDWOOD) FOREST

These lowland forests are typical of river-bottom floodplains. Willow (*Salix nigra*) or cottonwood (*Populus deltoides*) dominate in wet southern hardwoods, while silver maple (*Acer saccharinum*), American elm (*Ulmus americana*), or ash (*Fraxinus* spp.) dominate in wet-mesic southern hardwoods. River birch (*Betula nigra*) is also a frequent component. Herpetologically, these communities are very rich, containing the central newt, blue-spotted salamander, eastern gray treefrog, northern spring peeper, green frog, wood frog, Blanding's turtle, eastern hognose snake, western fox snake, northern water snake, and eastern massasauga.

SOUTHERN MESIC (MAPLE-BEECH) FOREST

Sugar maple (*Acer saccharum*) and beech (*Fagus grandifolia*) comprise over 90% of the forest canopy. The understory is sparsely vegetated except for spring ephemerals and vegetation in occasional openings. Similarly, the herpetofauna is scant; the northern spring peeper, wood frog, four-toed salamander, and northern ringneck snake are characteristic species.

SOUTHERN XERIC (OAK OR OAK-HICKORY) FOREST

These forests are found on dry upland sites; bur oak (*Quercus macrocarpa*), black oak (*Q. velutina*), or white oak (*Q. alba*) dominate in southern dry hardwoods, and red oak (*Q. rubra*) or basswood (*Tilia americana*) dominate in dry-mesic sites. The canopy of these dry upland forests is sparse enough to allow sufficient light for a dense understory of herbs and shrubs. Hickory (*Carya* spp.), sugar maple (*Acer saccharum*), and cherry (*Prunus serotina*) often are subdominant species in these communities. The blue-spotted salamander, eastern tiger salamander, eastern gray treefrog, northern spring peeper, brown snake, and black rat snake comprise the herpetofauna in this community.

WET AND WET-MESIC PRAIRIE

Wet and wet-mesic prairies are open wet lowland meadows dominated by reed grasses (*Calamagrostis* spp.) and slough grasses (*Spartina* spp.). The swales and potholes of lowland prairies afford ideal breeding and foraging grounds for the central newt, eastern tiger salamander, American toad, western chorus frog, southern gray treefrog, Blanding's turtle, painted turtle, eastern hognose snake, and eastern garter snake.

MESIC PRAIRIE

Mesic prairies are characterized by deep rich soils that support a flora dominated by composites, grasses, and legumes. The blue racer, bullsnake, smooth green snake, eastern massasauga, and eastern plains garter snake are characteristic reptiles of this community.

XERIC (DRY OR HILL) PRAIRIE

Remnants of prairies are now found primarily on the thin soil overlying bedrock of hillsides dominated by grama grasses (*Bouteloua* spp.) and little bluestem grass (*Andropogon scoparius*). Dry and dry-mesic prairie occurs on sites with deep sandy soil, often near river floodplains. The six-lined racerunner, eastern milk snake, blue racer, and bullsnake are representative species of these prairies.

TALL SHRUB (SHRUB-CARR AND ALDER THICKET) COMMUNITIES

These dense shrubby communities occur mainly along cold creeks and streams. Alder thickets (*Alnus rugosa*) dominate the shrub-carr north of the tension zone, whereas willows (*Salix* spp.) and dogwoods (*Cornus* spp.) dominate communities south of this zone. The pickerel frog, northern leopard frog, northern water snake, eastern milk snake, and queen snake thrive in these communities.

BEACH AND LAKE DUNE COMMUNITIES

These early successional communities occur along the Lake Michigan shoreline and vary considerably depending on the depth of water and on wind and wave action. They are sparsely vegetated communities on sandy soil with sea rocket (*Cakile edentula*), beach grass (*Ammophila breviligulata*), and beach-pea (*Lathyrus maritimus*) often appearing as dominant species. The six-lined racerunner is characteristic of dune communities in Indiana.

Lakes, large ponds, and rivers are inhabited by the mudpuppy, central newt, common snapping turtle, stinkpot, Blanding's turtle, painted turtle, and eastern spiny softshell. The peripheries of lakes, large ponds, and large rivers are inhabited by the green frog, bullfrog, Blanchard's cricket frog, northern water snake, and eastern garter snake.

Scattered open-water marshes characterized by cattail (*Typha* spp.) and bulrush (*Scirpus* spp.) are inhabited by the eastern tiger salamander, central newt, American toad, western chorus frog, southern gray treefrog, northern leopard frog, common snapping turtle, painted turtle, Blanding's turtle, and eastern garter snake.

Cold spring ponds, spring-fed creeks, and fens are characteristic habitat for the four-toed salamander, pickerel frog, and queen snake.

ECONOMIC, ECOLOGICAL, AND AESTHETIC IMPORTANCE OF AMPHIBIANS AND REPTILES

Most people recognize that herpetofauna have an important function in natural communities but few consider them to be economically important. True,

they do not approach the money value of game animals and fur bearers, but the direct income and indirect economic value of the amphibians and reptiles are quite significant. An obvious direct economic value is derived from the harvest of animals for sale to biological supply houses, pet shops, and restaurants. More subtle is the value gained from the technical use of the animals. Thousands are used annually for cancer research, pesticide and herbicide toxicity studies, biological education, pregnancy tests, virus work, and countless other forms of medical and technical research. Further, the herpetofauna are important food sources for a wide variety of the more economically important animals and game fish.

ECONOMIC AND ECOLOGICAL IMPORTANCE

Frogs and Toads

As a group, frogs are probably the herpetofauna of greatest economic importance. Biological supply houses centered in Oshkosh, Wisconsin, harvest approximately 160,000 leopard frogs each year from locations within Wisconsin (Vogt, 1976--unpublished). The actual number taken throughout the Basin is unknown. The impact that this action has on natural populations has not been assessed. Bullfrogs are the second most important amphibian from a direct economic standpoint. Restaurants, as well as biological supply houses, use substantial numbers of bullfrogs, for the legs of this species are eaten as a delicacy.

In addition to the direct economic benefits derived from these species, frogs have some importance in insect control. Leopard frogs spend much of the summer months foraging on insects in fields away from water (Dole, 1965; Ritchoff, 1975). Bullfrogs consume a wide variety of aquatic insects and other frogs. Although bullfrogs were once considered a serious threat to hatchling waterfowl and young turtles, a food-habit study of bullfrogs in South Dakota indicates that this is, in fact, not the case (Hammer and Linder, 1969).

Frogs also provide food for other animals, contributing biomass derived from extensive resources generally unavailable for direct use by consumers of higher trophic levels. Anurans (frogs and toads) and their tadpoles transform algae and insects into usable energy (secondary production) for organisms of higher trophic levels. Leopard frogs and American toads lay up to 6000 and 8000 eggs, respectively (Wright and Wright, 1949). The eggs are fed upon readily by fish, salamanders, and aquatic invertebrates. The explosive hatching of thousands of tadpoles produces an abundant food source for fish, snakes, turtles, salamanders, and shore birds. With the onset of metamorphosis, frogs are relished by mammalian predators [raccoon, skunk, fox, otter, mink, weasel (Jackson, 1961)], avian predators [red-shouldered hawks (Hamerstrom, 1972), bitterns, herons, crows], snakes [garter snakes, ribbon snakes, water snakes], and turtles [snapping turtles, Blanding's turtles (Minton, 1972; Smith, 1961; Vogt, 1976--unpublished)].

Salamanders

The sale of salamanders in the Basin is not as extensive as that of frogs, but mudpuppies, tiger salamanders, and spotted salamanders are collected and sold by the biological supply house industry. Newts and *Ambystoma* larvae are sold for fish bait.

Salamanders are invertebrate predators, but their actual value in controlling pest species is unknown. Newts, mudpuppies, and many fish species consume the same or similar food items. Minton (1972) and Neess (1970) indicated that mudpuppies do not seriously affect fish populations by consuming their eggs. Blue-spotted and tiger salamanders consume a variety of insects and earthworms. In general, salamanders do not inhabit cultivated areas and consequently neither hinder nor enhance crop production.

Salamanders, like anurans, are important food sources for other vertebrates. The larvae are carnivorous, feeding mainly on invertebrates and other amphibian eggs (Walters, 1975). Because adult salamanders are usually secretive and have noxious skin secretions, larval forms are probably a more important food source for other vertebrates. Larval stages of ambystomatid salamanders are consumed by fish, wading birds, and larger salamander larvae (Martin *et al.*, 1961). Newts and mudpuppies are available year-round as food sources, whereas larval ambystomatids are encountered only in late spring and summer.

Turtles

Turtles represent the reptilian group of greatest economic importance in the Basin. Snapping turtles and softshell turtles are commercially harvested and sold to restaurants that serve turtle soup as a delicacy. The total number of turtles used as food is unknown but turtles sold in 1975 were priced from 45¢-75¢/lb live weight in Wisconsin markets (Vogt, 1976--unpublished). Also, large numbers of snapping turtles, wood turtles, and painted turtles have been harvested by the biological supply house industry. In Wisconsin 41,975 turtles were reported sold by the three major Wisconsin supply houses in 1972 (Wis. Dep. Nat. Resour., 1973). Due to new Department of Agriculture health standards, the mail order turtle trade is being severely restricted. This restriction may actually help preserve many turtles, considering the longevity and long replacement time of most turtle populations. Heavy harvesting of adult animals of slow-maturing species leads to the rapid extirpation of such species.

The turtles' most important role in the ecosystem is probably their utility as a food source for animals of higher trophic levels. Snapping turtles will reproduce for over 20 years (Hammer, 1973), potentially laying at least 600 eggs during this time span. Most of these, as is the situation with the eggs of other turtles, are destroyed by nest predation. Minks, weasels, skunks, foxes, coyotes, raccoons, and thirteen-lined ground squirrels excavate and devour turtle eggs (Hammer, 1969; Jackson, 1961; Ream, 1967). Turtle hatchlings also become prey for these same mammalian predators, many birds (gulls, herons, bitterns, crows, blackbirds), bullfrogs, and fish (Vogt, 1976--unpublished). In general, once turtles attain sexual maturity they are relatively free from most natural predators.

Some turtles in the Basin play an important role in scavenging and mollusk control. Snapping turtles, painted turtles, and softshell turtles readily consume carrion, aquatic insects, fish and crustaceans (Pope, 1944; Lagler, 1943). Musk turtles and map turtles feed primarily on mollusks, effectively destroying vast numbers of snails, which are hosts to fish parasites (Minton, 1972).

Coulter (1957) reported that snapping turtles were responsible for 10-13% of the total brood predation at a waterfowl rearing area in the northeastern United States. Hammer (1973), however, postulated that snapping turtles probably do not adversely affect waterfowl production. He contended that predation of turtle nests by mammals results in less predation of waterfowl nests, and he suggested that this buffering effect far outweighs any direct damage by snapping turtles to waterfowl.

Lizards

The three lizard species found in the Basin are so limited in abundance that they are of little economic consequence. All three species are insectivorous but probably are not important in the control of injurious insects. Lizards provide a food source for hawks and snakes but, because of their scarcity, cannot be considered of major ecological importance in the Basin.

Snakes

Snakes offer both ecological and economic benefits. The sale of native snakes in pet shops and biological supply houses is not a major economic enterprise. Rather, the major value of snakes inhabiting the Basin is in the control of rodents and insects. Bullsnares, fox snakes, milk snakes, and black rat snakes feed primarily on rodents. Hisaw and Gloyd (1926) suggested that a bullsnake was worth about \$3.75 a year to the Iowa farmer, which is at least \$50 by 1976 standards. Water snakes and garter snakes serve as checks on fish populations, often consuming sick and injured individuals. In addition, they consume a variety of other organisms such as anurans, crayfish, earthworms, and insects. The northern brown snake, red-bellied snake, ringneck snake, and garter snakes rely heavily on invertebrates for food and therefore may have some use in pest control. Adult snakes are readily preyed upon by the striped skunk, various hawks, and other birds while their eggs are consumed by many mammalian predators (Hamerstrom, 1972; Jackson, 1961).

AESTHETIC IMPORTANCE

Although a number of people have no desire to see any member of the amphibian-reptile group in the wild, naturalists, hikers, and especially small children find all of them intriguing. To these people and many others, the first call of the spring peepers is a welcome sound, and the sight of a blue racer slithering through the grass is exciting. Accordingly, no discussion of the value of amphibians and reptiles would be complete without a reminder that the aesthetic values must be taken into account.

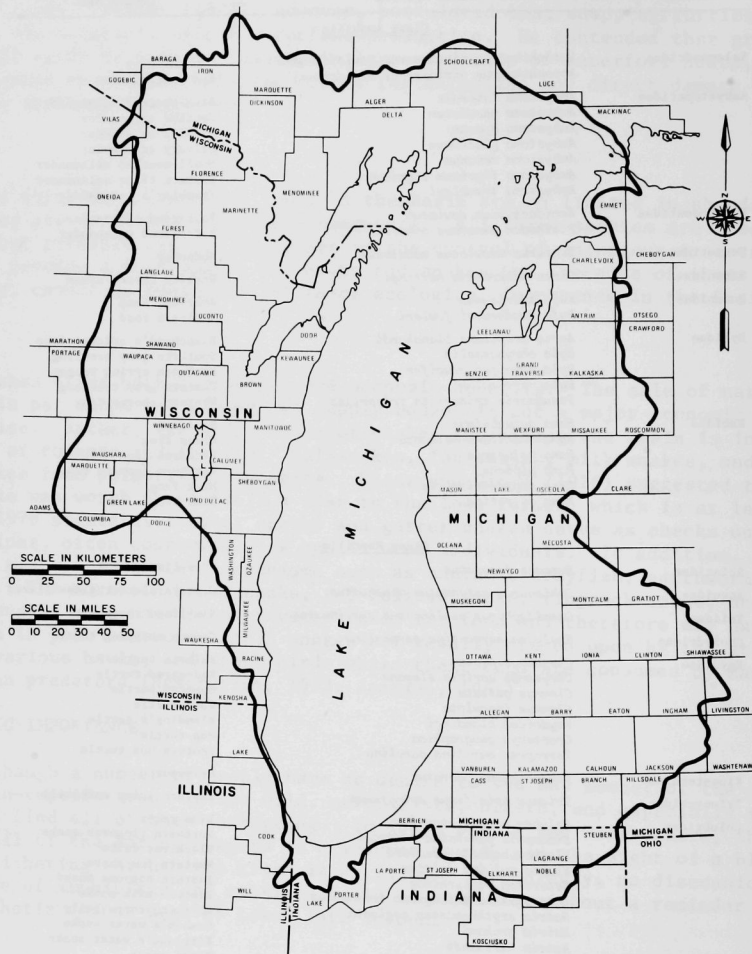
ANNOTATED CHECKLIST OF AMPHIBIANS AND REPTILES OF THE LAKE MICHIGAN BASIN

A total of 25 amphibian and 34 reptilian species are currently believed to inhabit a variety of habitats within the Lake Michigan Drainage Basin (Table 1). Information has been included in the Annotated Checklist on status (rare, common, abundant), diet, reproduction and habitat requirements for each species in the Basin. Species considered as *rare* occur in only a few localities in the Basin, and in relatively small numbers. A *common* status indicates that the species occurs in relatively large numbers at many localities throughout the Basin. *Abundant* species are those encountered in high population densities

Table 1. Amphibians and Reptiles of the Lake Michigan Drainage Basin

Family	Genus Species	Common Name
<u>Class Amphibia</u>		
Salamandridae	<i>Notophthalmus viridescens louisianensis</i> <i>Notophthalmus viridescens viridescens</i>	Central newt Red-spotted newt
Ambystomatidae	<i>Ambystoma laterale</i> <i>Ambystoma maculatum</i> <i>Ambystoma opacum</i> <i>Ambystoma platineum</i> <i>Ambystoma texanum</i> <i>Ambystoma tigrinum tigrinum</i> <i>Ambystoma tremblayi</i>	Blue-spotted salamander Spotted salamander Marbled salamander Silvery salamander Small-mouthed salamander Eastern tiger salamander Tremblay's salamander
Plethodontidae	<i>Hemidactylum scutatum</i> <i>Plethodon cinereus cinereus</i>	Four-toed salamander Red-backed salamander
Necturidae	<i>Necturus maculosus maculosus</i>	Mudpuppy
Sirenidae	<i>Siren intermedia nettingi</i>	Western lesser siren
Bufonidae	<i>Bufo americanus</i> <i>Bufo woodhousei fowleri</i>	American toad Fowler's toad
Hylidae	<i>Acris crepitans blanchardi</i> <i>Hyla chrysoscelis</i> <i>Hyla crucifer crucifer</i> <i>Hyla versicolor</i> <i>Pseudacris triseriata triseriata</i>	Blanchard's cricket frog Southern gray treefrog Northern spring peeper Eastern gray treefrog Western chorus frog
Ranidae	<i>Rana catesbeiana</i> <i>Rana clamitans melanota</i> <i>Rana palustris</i> <i>Rana pipiens</i> <i>Rana septentrionalis</i> <i>Rana sylvatica</i>	Bullfrog Green frog Pickerel frog Northern leopard frog Mink frog Wood frog
<u>Class Reptilia</u>		
Scincidae	<i>Eumeces fasciatus</i>	Five-lined skink
Anguidae	<i>Ophisaurus attenuatus attenuatus</i>	Western slender glass lizard
Teiidae	<i>Cnemidophorus sexlineatus sexlineatus</i>	Six-lined racerunner
Chelydridae	<i>Chelydra serpentina serpentina</i>	Common snapping turtle
Emydidae	<i>Chrysemys picta</i> <i>Chrysemys scripta elegans</i> <i>Clemmys guttata</i> <i>Clemmys insculpta</i> <i>Emydoidea blandingi</i> <i>Graptemys geographica</i> <i>Terrapene carolina carolina</i>	Painted turtle Red-eared turtle Spotted turtle Wood turtle Blanding's turtle Map turtle Eastern box turtle
Kinosternidae	<i>Sternotherus odoratus</i>	Stinkpot
Trionychidae	<i>Trionyx spiniferus spiniferus</i>	Eastern spiny softshell
Colubridae	<i>Coluber constrictor foxi</i> <i>Diadophis punctatus edwardsi</i> <i>Elaphe obsoleta obsoleta</i> <i>Elaphe vulpina vulpina</i> <i>Heterodon platyrhinos</i> <i>Lampropeltis triangulum triangulum</i> <i>Natrix erythrogaster neglecta</i> <i>Natrix grahami</i> <i>Natrix kirtlandi</i> <i>Natrix septemvittata</i> <i>Natrix sipedon sipedon</i> <i>Ophedrys vernalis</i> <i>Pituophis melanoleucus sayi</i> <i>Storeria dekayi</i> <i>Storeria occipitomaculata occipitomaculata</i> <i>Thamnophis butleri</i> <i>Thamnophis proximus proximus</i> <i>Thamnophis radix radix</i> <i>Thamnophis sauritus septentrionalis</i> <i>Thamnophis sirtalis sirtalis</i>	Blue racer Northern ringneck snake Black rat snake Western fox snake Eastern hognose snake Eastern milk snake Northern copperbelly Graham's water snake Kirtland's water snake Queen snake Northern water snake Smooth green snake Bullsnake Brown snake Northern red-bellied snake Butler's garter snake Western ribbon snake Eastern plains garter snake Northern ribbon snake Eastern garter snake
Viperidae	<i>Sistrurus catenatus catenatus</i>	Eastern massasauga

at many localities throughout the Basin. A reference map showing the counties in the Basin follows.



Counties in the Lake Michigan Drainage Basin.

Following the Annotated Checklist is a list of amphibians and reptiles considered to have limited distribution within the Basin (Table 2). The term *limited* refers to species which consist of disjunct populations which (1) may or may not have similar distribution over other portions of their range and (2) may be uncommonly encountered throughout their range although their habitat may be somewhat continuous. Some of these species are considered rare, threatened, or endangered in those states comprising the Basin.

AMPHIBIANS OF THE REGION

SALAMANDRIDAE - NEWTS

Notophthalmus viridescens louisianensis (Wolterstoff). CENTRAL NEWT.

Status: Abundant throughout Basin (Fig. 1).

Habitat: Ponds, lakes, swales in woodlands, and open areas of southern and northern lowland forests, northern mesic forest, oak savanna, and southern mesic forest.

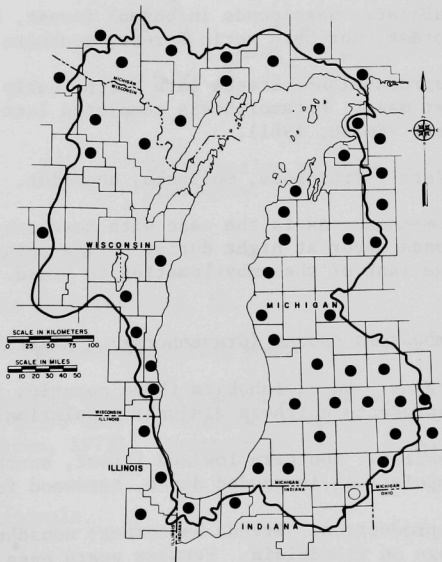
Reproduction: Mating, oviposition (egg laying) late winter or early spring. Eggs laid singly, attached to submerged vegetation. Hatching 2-3 weeks. Metamorphosis 2-3 months after egg-laying (Smith, 1961). Land stage called eft. Attains sexual maturity 2-3 years (Smith, 1961).

Diet: Mollusks, crustaceans, amphibian eggs; varies between aquatic and terrestrial stages (Minton, 1972; Smith, 1961).

Comments: The eft stage is rare in Wisconsin. Some Michigan populations are comprised largely of neotenic (sexually mature in larval stages with metamorphosis never completed) individuals. The red-spotted newt (*N. viridescens viridescens*) (Fig. 1) is known to inhabit northeastern Indiana (Conant, 1975). Its habitat, breeding requirements, and diet are similar to that of the central newt.

Fig. 1.

Distribution of *Notophthalmus viridescens louisianensis* ●, and *N. v. viridescens* ○.



AMBYSTOMATIDAE - MOLE SALAMANDERS

Ambystoma laterale Hallowell. BLUE-SPOTTED SALAMANDER.

Status: Common throughout Basin (Fig. 2).

Habitat: Wooded, swampy areas having sandy soils (Minton, 1972). Southern lowland forest, southern mesic hardwoods, northern mesic forest, boreal forest in Wisconsin.

Reproduction: Oviposition late March or early April in Chicago area (Stille, 1954a). Eggs laid singly, clumps of two, three, or four (Uzzell, 1967) on pond bottoms, submerged vegetation. Up to 13 eggs per clutch in Wisconsin.

Diet: Springtails, slugs, snails, beetle larvae, beetles, dipteran larvae.

Comments: Many of the early specimens catalogued as *A. jeffersonianum* (Jefferson's salamander) in the Michigan Museum of Zoology are likely *A. laterale* or *A. tremblayi* since *A. jeffersonianum* is absent from the Basin. Distinguishing between members of the *A. jeffersonianum* complex has posed a difficult problem for taxonomists. Uzzell (1964) observed slight differences in external morphological characteristics as well as differences in erythrocyte volumes.

Ambystoma maculatum (Shaw). SPOTTED SALAMANDER.

Status: Common; occurs throughout Basin (Fig. 3).

Habitat: Near ponds in boreal forest, northern mesic (northern hardwood) forest, northern xeric forest, southern mesic forest.

Reproduction: Breeds late March, early April. Egg masses globular; 50-150 per mass. Metamorphosis completed late June to mid-August for Illinois specimens (Smith, 1961).

Diet: Arthropods, mollusks, annelids.

Comments: As is the case with most ambystomatids, migrations to breeding ponds occur at night during spring rains. In Indiana, spotted salamanders are the last of the ambystomatids to breed.

Ambystoma opacum (Gravenhorst). MARBLED SALAMANDER.

Status: Rare; inhabits three counties in Basin (Fig. 4). Range in Basin represents northern disjunct population.

Habitat: Southern lowland forest, southern xeric forest. Northern Indiana populations in wooded dunes, hardwood forest (Minton, 1972).

Reproduction: Breeds September; nonadherent eggs deposited in groups under logs on floodplain. Females guard eggs until inundated by fall rains. Metamorphosis June or July of following year.

Diet: Arthropods, annelids, mollusks (Smith, 1961).

Comments: The marbled salamander is easily collected under rocks and logs throughout the active season. It is the only ambystomatid that does not lay eggs in water and whose eggs are attended by the female (Anderson, 1967b; Conant, 1975). Marbled salamanders are also the only ambystomatids to lay eggs in the fall. Smith (1961) states that *A. opacum* is more tolerant of dry conditions than is *A. maculatum*.

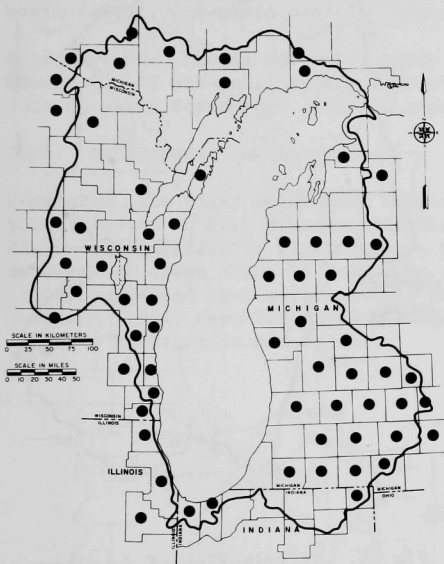


Fig. 2. Distribution of *Ambystoma laterale*.

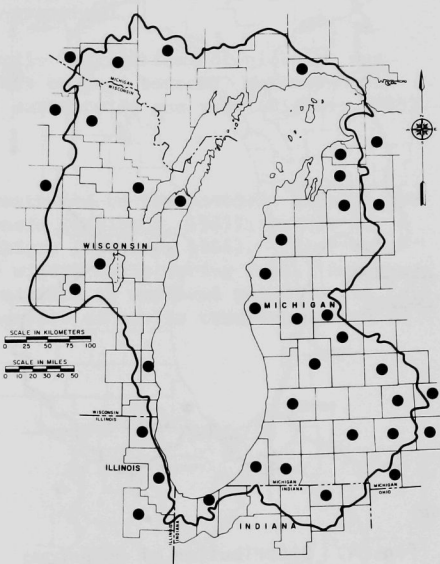


Fig. 3. Distribution of *Ambystoma maculatum*.

Ambystoma platineum (Cope). SILVERY SALAMANDER.

Status: Rare; known in only three Basin counties (Fig. 5).

Habitat: Southern mesic forest; forest patches encircling ponds.

Reproduction: Eggs laid in ephemeral ponds, usually attached to submerged vegetation in masses 3-4 cm (1-3/16 to 1-5/8 in.) in diameter (Uzzell, 1967). Egg-laying late March, early April (Minton, 1972). Duration of larval stage unknown.

Diet: Perhaps similar to that of *A. laterale*.

Comments: Sperm activation is not required for egg development; however, development percentages are low in the absence of sperm. This species is, in general, similar to *A. jeffersonianum* in morphological characteristics. *A. laterale* is usually found inhabiting the same microhabitat as *A. jeffersonianum*.

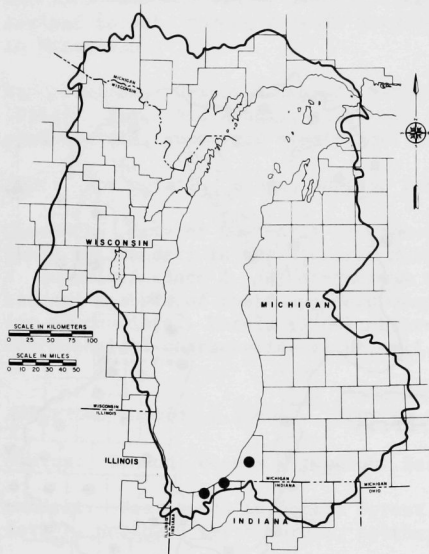


Fig. 4. Distribution of *Ambystoma opacum*.

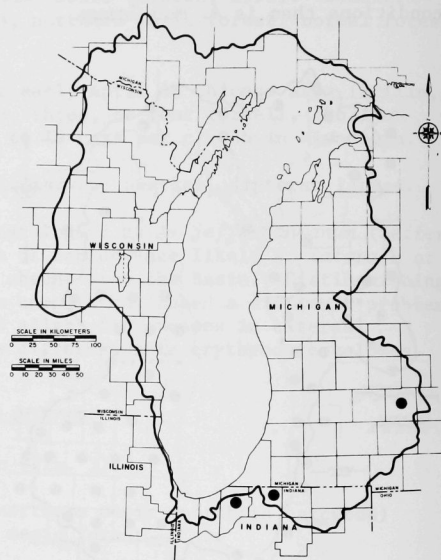


Fig. 5. Distribution of *Ambystoma platineum*.

Ambystoma texanum (Matthes). SMALL-MOUTHED SALAMANDER.

Status: Rare within Basin; common throughout most of range (Fig. 6).

Habitat: Southern lowland forest. Occupies tall grass prairie, floodplain forest, oak woodland, dense hardwood forest, and some farmland (Anderson, 1967a).

Reproduction: Breeds late March. Six to 30 eggs per mass; deposited on vegetation in shallow pools (Smith, 1961). Metamorphosis complete by June or July (Smith, 1961).

Diet: Annelids, arthropods.

Comments: Minton (1972) indicated that the best habitat in Indiana is forested bottomland (floodplain). He also stated that additional field study may result in new records from Steuben, Noble, and La Grange counties in Indiana. Small-mouthed salamanders are often encountered in breeding ponds along with spotted

and tiger salamanders. Oviposition was observed in a grassland pond near Urbana, Illinois, in early March of 1970 by the senior author.

Ambystoma tigrinum tigrinum (Green). EASTERN TIGER SALAMANDER.

Status: Abundant; common within lower two-thirds of Basin (Fig. 7).

Habitat: Inhabits deciduous forests and prairies. Southern xeric, southern mesic forest, wet-mesic prairie, bracken-grassland.

Reproduction: Breeds March and early April. Cylindrical or globular egg masses (20-50 per mass) attached to objects on pond bottom. Metamorphosis July to early September. Attains sexual maturity in one year (Oliver, 1955).

Diet: Arthropods, earthworms.

Comments: The tiger salamander ranges northward to the southern edge of the boreal forest in both Michigan and Wisconsin (Gehlback, 1967), except for a disjunct population in Alger County, Michigan (Hensley, 1964). Tiger salamanders are often found in basements and window wells during fall. Smith (1961) suggested that mature adults may migrate to woodland ponds in the fall. Duellman (1954) reported finding large numbers of adults crossing a road in southern Michigan in mid-October.

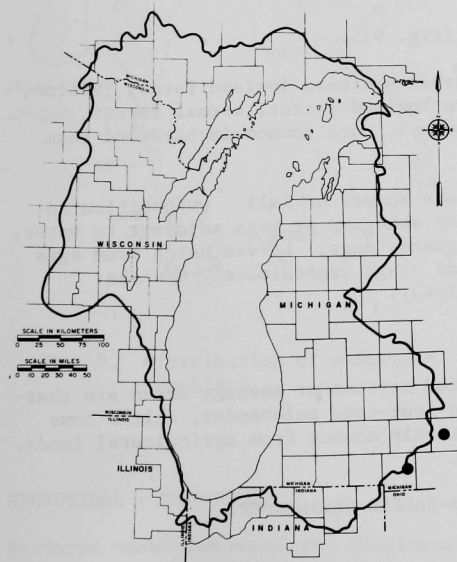


Fig. 6. Distribution of *Ambystoma texanum*.

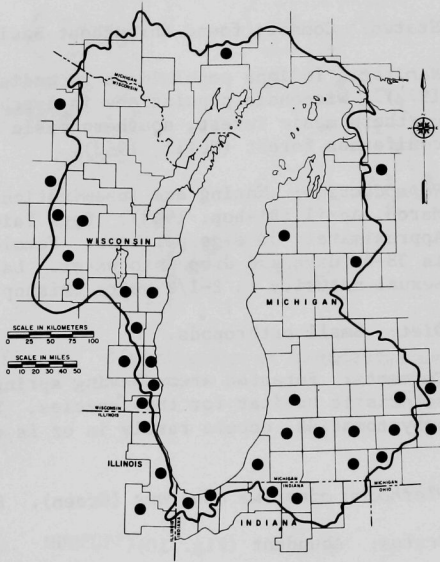


Fig. 7. Distribution of *Ambystoma tigrinum tigrinum*.

Ambystoma tremblayi Comeau. TREMBLAY'S SALAMANDER.

Status: Rare (Fig. 8).

Habitat: Similar to that of *A. laterale*. Always found in association with *A. laterale*. Indiana specimens in southern mesic forests bordering lakes or small ponds (Minton, 1972).

Reproduction: Eggs deposited in small clusters on pond bottom or attached to sticks in woodland ponds, late March or April. Metamorphosis late June in Indiana specimens (Minton, 1972).

Diet: No data available; probably similar to that of *A. laterale*.

Comments: This species consists almost exclusively of triploid females (3N = 42). Additional information concerning the mechanism for maintenance of triploidy in this species as well as a more complete morphological description can be found in Uzzell (1967). There was originally some question as to the necessity of *A. laterale* sperm for the development of *A. tremblayi* eggs (Uzzell, 1964). Indiana eggs have developed without sperm activation (Minton, 1972).

PLETHODONTIDAE - LUNGLESS SALAMANDERS

Hemidactylium scutatum (Schlegel). FOUR-TOED SALAMANDER.

Status: Common; found throughout Basin (Fig. 9).

Habitat: Indiana populations in undisturbed southern lowland forest (Minton, 1972). Wisconsin populations in northern lowland forest, boreal forest, northern mesic forest, southern mesic forest. More common in hardwood than coniferous forest (Neill, 1963).

Reproduction: Mating and insemination late summer or fall. Oviposition in March, April (Bishop, 1943). Eggs laid in sphagnum or moss adjacent to water. Approximately 30 eggs per mass. Female guards eggs. Larvae hatch from eggs in 38-60 days and drop into water. Larval stage approximately 6 weeks. Sexual maturity in 2-1/2 years (Bishop, 1943).

Diet: Small arthropods.

Comments: Forested areas having spring-fed streams or seepage areas are characteristic habitat for this species. The four-toed salamander, unlike some ambystomatids, occurs rarely in or is entirely absent from agricultural lands.

Plethodon cinereus cinereus (Green). RED-BACKED SALAMANDER.

Status: Abundant (Fig. 10).

Habitat: Boreal forest, northern mesic forest, southern mesic forest, southern xeric forest.

Reproduction: Mating October to December. Egg-laying June or July. Six to 12 eggs, laid singly within cavities of rotting logs. Female guards eggs. Newly metamorphosed individuals appear August and September (Minton, 1972). Sexual maturity approximately two years for southern Michigan populations (Minton, 1972).

Diet: Insect larvae, spiders, annelids, beetles, snails.

Comments: Unlike other salamanders in the Basin, larval stages do not require external water for development. Microtopographical differences, soil moisture, and the physical condition of logs has been shown to influence the local distribution of individuals inhabiting a beech-maple forest in Michigan (Heatwole, 1962).

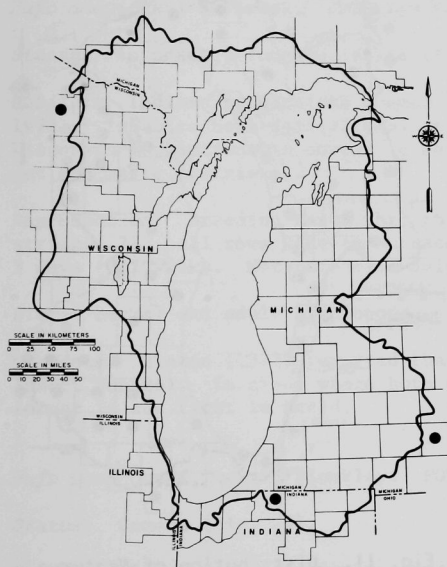


Fig. 8. Distribution of *Ambystoma tremblayi*.

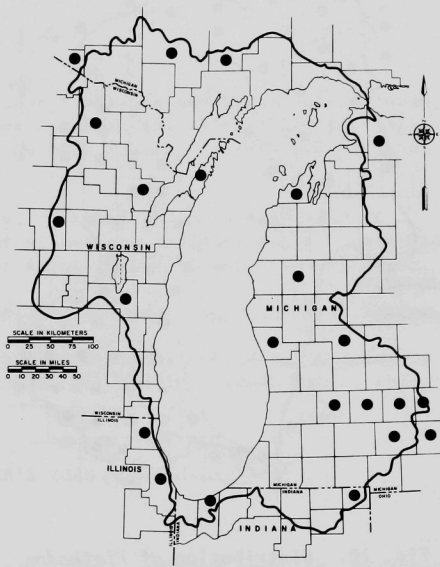


Fig. 9. Distribution of *Hemidactylium scutatum*.

NECTURIDAE - MUDPUPPIES

Necturus maculosus maculosus (Rafinesque). MUDPUPPY.

Status: Common (Fig. 11).

Habitat: Entirely aquatic. Common in shallow water of lakes or streams throughout Basin.

Reproduction: Mating in late fall; eggs attached to roof of shallow excavations under submerged objects (Bishop, 1943). Hatching in 38-63 days depending upon water temperature (Minton, 1972). Sexual maturity in fifth year in New York (Oliver, 1955).

Diet: Aquatic crustaceans (crayfish), aquatic insects (Minton, 1972), annelids, mollusks, amphibians, fish eggs.

Comments: Mudpuppies are very rare or absent from heavily polluted water bodies, marshes, or small creeks (Minton, 1972). Stone rip-rap (used to secure marshes in Wisconsin) provides excellent nesting habitat.

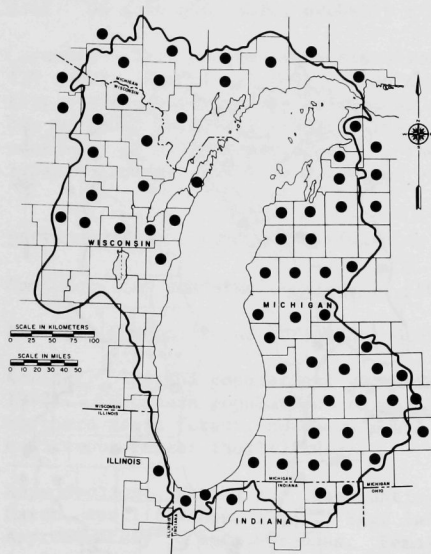


Fig. 10. Distribution of *Plethodon cinereus cinereus*.

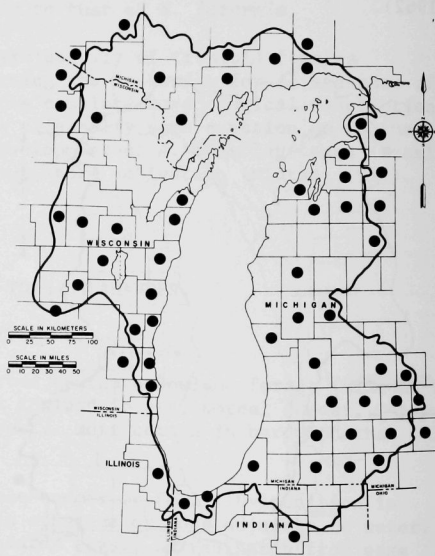


Fig. 11. Distribution of *Necturus maculosus maculosus*.

SIRENIDAE - SIRENS

Siren intermedia nettingi Goin. WESTERN LESSER SIREN.

Status: Rare (Fig. 12).

Habitat: Permanently aquatic. Ditches and sloughs in southern Illinois (Smith, 1961). Indiana populations in warm, shallow, turbid waters of swamps, stock ponds, drainage ditches (Minton, 1972).

Reproduction: Breeds early spring. Approximately 200 eggs deposited in 5-cm (2-in.) depression in pond bottom (Martof, 1973). Sexual maturity in two years.

Diet: Filamentous algae, submerged plants, midge larvae (Chironomidae) (Davis and Knapp, 1953); terrestrial insects, earthworms (Minton, 1972).

Comments: This species is common in a belt extending southward from southern Illinois through Mexico. Its appearance as far north as Michigan is unusual. Williams (1961) found two dead specimens on the shore of Saddle Lake in Allegan County, Michigan (Fig. 12), and suggested that the species may have been introduced by fishermen using the sirens as bait. It is also possible that the species migrated northward via a series of waterways and shoreline to the Black River, which connects to Saddle Lake.

BUFONIDAE - TOADS

Bufo americanus Holbrook. AMERICAN TOAD.

Status: Abundant throughout Basin (Fig. 13).

Habitat: Indiana populations common in open woodlands and grasslands (Minton, 1972). Inhabits both agricultural and wooded areas in Illinois (Smith, 1961). Wisconsin populations in boreal forest, southern lowland forest, oak savanna, wet and mesic prairies.

Reproduction: Breeding March through May. Several thousand eggs laid in strings, 2-3 cell rows wide on surface of almost any standing water. Hatching 3 days to 2 weeks. Metamorphosis July or August. Sexual maturity 1-2 years.

Diet: Larval and adult arthropods, especially insects. Opportunistic feeder.

Comments: Minton (1972) reported that this species has considerable value in insect control. In areas where both American and Fowler's toads occur, the former is the first to breed.

Bufo woodhousei fowleri Hinckley. FOWLER'S TOAD.

Status: Common (Fig. 14).

Habitat: Oak savanna; common in sand dunes, xeric prairies near Lake Michigan (Minton, 1972). Sandy soil areas in open woodlands.

Reproduction: Breeding late April through June (Smith, 1961). Several thousand eggs laid in long strands on water surface. Hatching one week. Metamorphosis late June or July (Smith, 1961). Sexual maturity end of second season following metamorphosis.

Diet: Larval and adult arthropods, mainly insects.

Comments: Hybridization between *B. americanus* and *B. woodhousei fowleri* occurs in areas where habitat degradation has occurred, allowing the species to occupy similar areas. *B. w. fowleri* occupies more xeric habitats than does *B. americanus*. Newly metamorphosed individuals were observed near a temporary pool in Indiana Dunes State Park in mid-July of 1973.

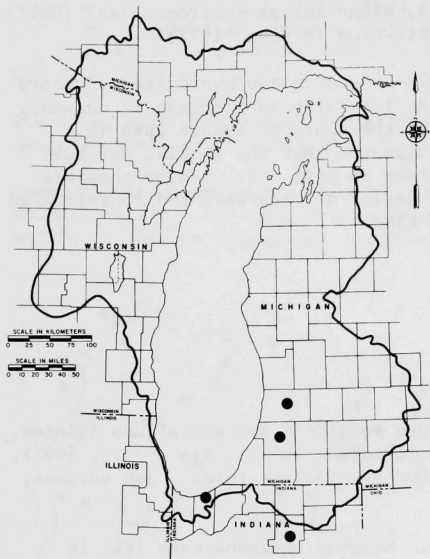


Fig. 12. Distribution of *Siren intermedia nettingi*.

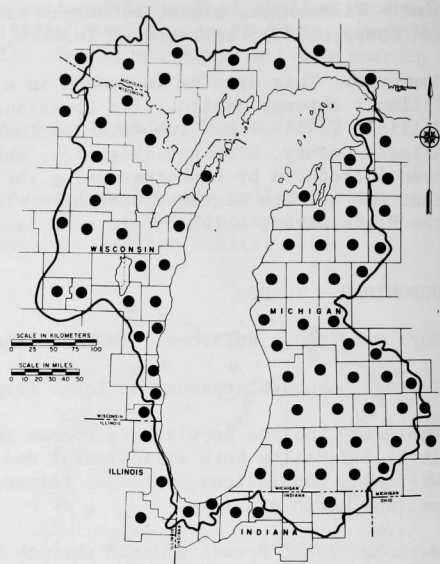


Fig. 13. Distribution of *Bufo americanus*.

HYLIDAE - TREEFROGS AND THEIR ALLIES

Acris crepitans blanchardi Harper. BLANCHARD'S CRICKET FROG.

Status: Common; locally abundant in southern one-third of Basin (Fig. 15).

Habitat: Quiet, permanent water such as lakes, farm ponds, drainage ditches, and strip mine ponds (Minton, 1972). Abundant in ponds surrounded by emergent vegetation. In Wisconsin, southern lowland forest along rivers and marshes.

Reproduction: Breeds mid-May through June (Minton, 1972). Eggs 200-300 laid singularly or in small masses attached to submerged objects (Wright and Wright, 1949). Metamorphosis July through August (Minton, 1972).

Diet: Beetle larvae, spiders, midge larvae, springtails (Minton, 1972).

Comments: Wisconsin populations are presently very low (Knudsen, 1975--personal communication). Cricket frogs seem to be highly susceptible to pesticides and pollution (Minton, 1972). Although it does not breed until mid-May, *A. crepitans* is one of the first frog species to emerge from hibernation.

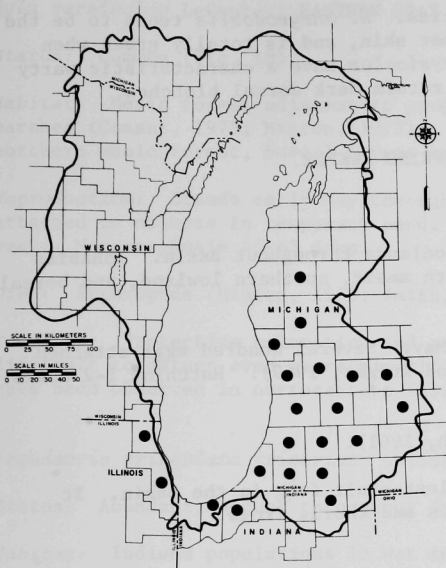


Fig. 14. Distribution of *Bufo woodhousei fowleri*.

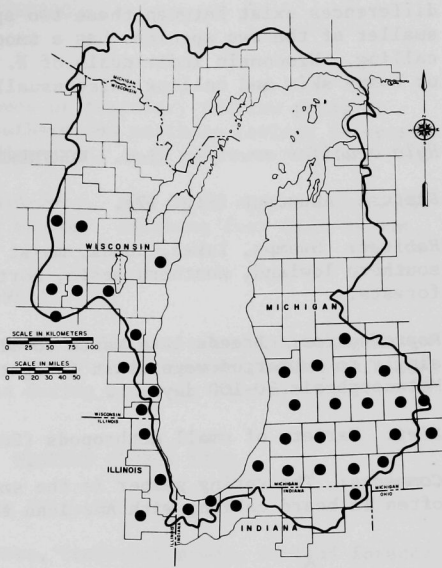


Fig. 15. Distribution of *Acris crepitans blanchardi*.

Hyla chrysoscelis Cope. SOUTHERN GRAY TREEFROG.

Status: Common (Fig. 16).

Habitat: Wet and wet-mesic prairies, oak savanna, northern xeric forest, northern mesic forest, northern lowland forest.

Reproduction: Breeding early May through June. Eggs singly or in small clusters attached to vegetation in ponds and swamps. Metamorphosis June and July.

Diet: Arthropods.

Comments: The occurrence of southern gray treefrogs in Illinois and Wisconsin has been documented only during the last ten years. In this time considerable attention has been given to distinguishing between southern and eastern gray treefrogs in areas of sympatry (overlapping ranges). Although there are no museum records of *H. chrysoscelis* from Michigan, the authors believe that many of the specimens identified as *H. versicolor* are actually *H. chrysoscelis*. Due to the close similarity in general size, external morphological characteristics, and calls of these two species, scrutiny should be used when attempting to distinguish between them. *H. chrysoscelis* has a more rapid and higher-pitched call than does *H. versicolor* (Zwiefel, 1970). Few consistent morphological

differences exist between these two species. *H. chrysoscelis* tends to be the smaller of the two species, has a smoother skin, and is totally green when calling. Wisconsin individuals of *H. versicolor* have a characteristic warty or bumpy skin and calling males usually retain dark dorsal blotches.

Hyla crucifer crucifer Wied. NORTHERN SPRING PEEPER.

Status: Abundant (Fig. 17).

Habitat: Swamps, lakes, ponds, moist woodlands throughout Basin. Inhabits southern lowland, southern mesic, northern mesic, northern lowland, and boreal forests.

Reproduction: Breeds late March to mid-May. Several hundred eggs attached singly to submerged vegetation (Wright and Wright, 1949). Hatching 1-2 weeks. Metamorphosis 90-100 days.

Diet: Variety of small arthropods (Smith, 1961).

Comments: The spring peeper is the smallest adult frog in the Basin. It often is heard calling with American toads and chorus frogs.

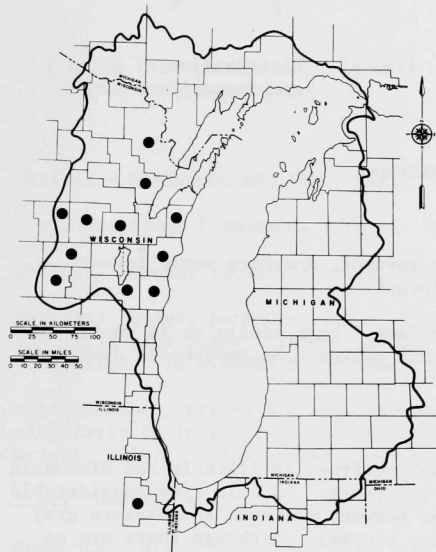


Fig. 16. Distribution of *Hyla chrysoscelis*.

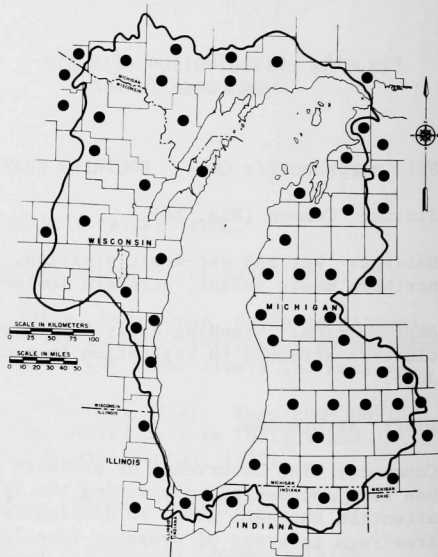


Fig. 17. Distribution of *Hyla crucifer crucifer*.

Hyla versicolor LeConte. EASTERN GRAY TREEFROG.

Status: Common (Fig. 18).

Habitat: Mesic forest adjacent to permanent or temporary shallow ponds or marshes (Conant, 1975; Minton, 1972). Southern and northern lowland forests, northern mesic forest, boreal forest in Wisconsin.

Reproduction: Breeds early May through mid-June. Six to 20 eggs in clusters, attached to objects in temporary ponds or swamps. Hatching four days to one week. Metamorphosis 45-65 days.

Diet: Arthropods (Minton, 1972; Smith, 1961).

Comments: Protective coloration and arboreal tendencies make this species difficult to detect even where plentiful. Newly metamorphosed individuals have been observed in northeastern Indiana during mid-July (Minton, 1972).

Pseudacris triseriata triseriata (Wied). WESTERN CHORUS FROG.

Status: Abundant; occurs throughout Basin (Fig. 19).

Habitat: Indiana populations in wet meadows, temporary ponds, lowland forests (Minton, 1972). In Wisconsin, found in ponds and marshes in oak savanna, southern mesic, northern mesic, and southern lowland forests.

Reproduction: Breeds late March through April. Eggs average 24 per mass, attached to submerged vegetation in temporary or permanent pools. Hatching one to two weeks. Metamorphosis 56-84 days (Minton, 1972).

Diet: Beetles (larvae and adults), spiders, amphipods (Minton, 1972).

Comments: Almost any temporary or permanent water body will attract this species. The reasons for the absence of western chorus frogs in northeastern Wisconsin and Michigan's Upper Peninsula are unknown.

RANIDAE - TRUE FROGS

Rana catesbeiana Shaw. BULLFROG.

Status: Common (Fig. 20).

Habitat: Most permanent water bodies throughout Basin (Smith, 1961). More common around lakes and ponds than along streams.

Reproduction: Breeds June and July. Several thousand eggs per female deposited on water surface. Metamorphosis July or August of second season. Sexual maturity one year after metamorphosis (Minton, 1972).

Diet: Crustaceans, insects (Smith, 1961).

Comments: Bullfrogs and leopard frogs are the amphibian species of greatest economic importance in the Basin.

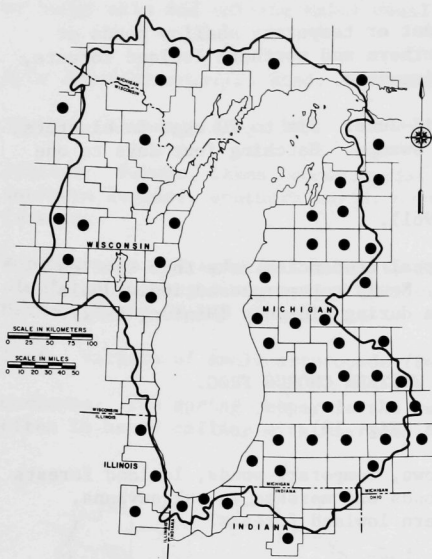


Fig. 18. Distribution of *Hyla versicolor*.

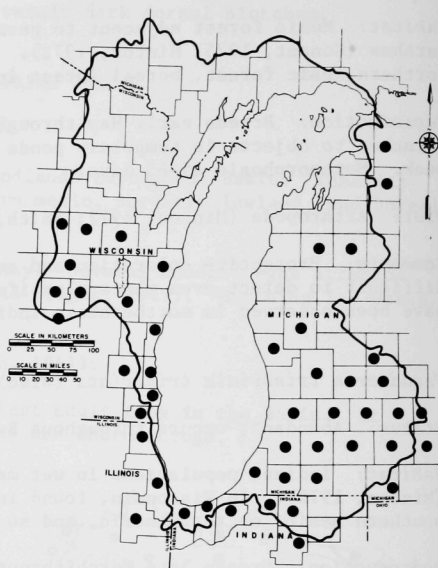


Fig. 19. Distribution of *Pseudacris triseriata triseriata*.

Rana clamitans melanota (Rafinesque). GREEN FROG.

Status: Abundant (Fig. 21).

Habitat: All types of permanent water bodies. Less common in prairies than in forests (Minton, 1972).

Reproduction: Breeding late June through July (Minton, 1972). Eggs 5000 per female, laid on water surface. Hatching late summer. Metamorphosis in June of season after hatching (Minton, 1972). Sexual maturity one year after metamorphosis.

Diet: Insects, annelids, mollusks (Smith, 1961; Minton, 1972).

Comments: Green frog males remain along pond peripheries throughout the active season and defend territories against intruding males (Martof, 1973; Wells, 1975--unpublished).



Fig. 20. Distribution of *Rana catesbeiana*.

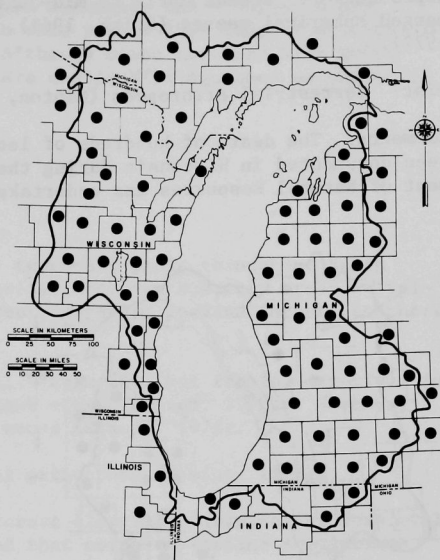


Fig. 21. Distribution of *Rana clamitans melanota*.

Rana palustris LeConte. PICKEREL FROG.

Status: Rare (Fig. 22).

Habitat: Cool, clear water bodies in forested portions of Basin (Smith, 1961). Around cold springs (Minton, 1972).

Reproduction: Breeding March through May. Egg masses globular, several hundred per mass. Eggs deposited in clear areas of lakes and springs (Smith, 1961). Hatching two weeks. Metamorphosis 70-80 days (Minton, 1972).

Diet: Arthropods, mollusks (Smith, 1961).

Comments: The color pattern of this species is mimicked by *Rana pipiens* in areas of sympatry in Wisconsin. The pickerel frogs produce noxious skin secretions (SchAAF and Smith, 1971).

Rana pipiens Schreber. NORTHERN LEOPARD FROG.

Status: Abundant (Fig. 23).

Habitat: Lakes, streams, rivers, and ponds. Often far from standing water (Minton, 1972; Smith, 1961). Uncommon in forested areas. Abundant in sedge meadows, wet prairies in Wisconsin.

Reproduction: Breeds April to mid-June. Eggs 3000-5000 in flattened, submerged spherical masses (Smith, 1961). Metamorphosis in 30-60 days (Minton, 1972).

Diet: Terrestrial arthropods (Minton, 1972).

Comments: The death of hundreds of leopard frogs as they enter hibernation has been documented in Wisconsin during the last three years. The Wisconsin Department of Natural Resources has undertaken a study to determine the cause.

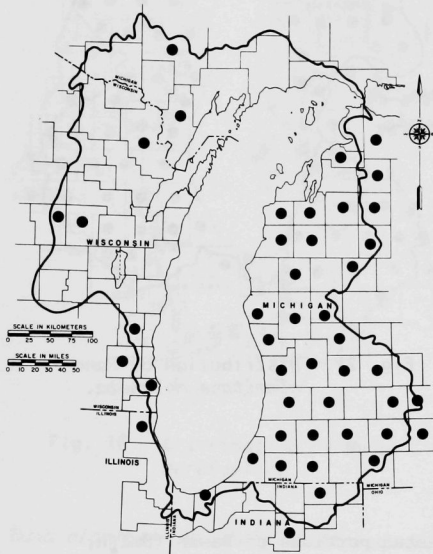


Fig. 22. Distribution of *Rana palustris*.

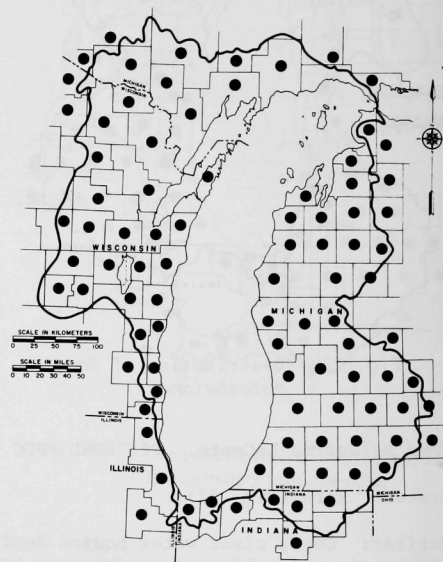


Fig. 23. Distribution of *Rana pipiens*.

Rana septentrionalis Baird. MINK FROG.

Status: Common (Fig. 24).

Habitat: Northern lowland forest, boreal forest. Lakes and ponds. Common along streams near lake entrances; often observed around lily pads (Conant, 1975).

Reproduction: Breeds late June through July (Wright and Wright, 1949). Several hundred eggs per submerged mass. Hatches late summer. Metamorphosis one year after eggs are laid (Wright and Wright, 1949).

Diet: Variety of arthropods; beetles, dragonflies, dipterans, various hymenopterans (Stewart and Sandison, 1972).

Comments: Mink frogs inhabit only northern Wisconsin and Michigan's Upper Peninsula within the Basin (Fig. 24). In this region they inhabit essentially the same habitat as does *R. clamitans*. Although often confused with green frog and bullfrog juveniles, mink frogs are easily distinguished on the basis of a strong, musky skin odor.

Rana sylvatica LeConte. WOOD FROG.

Status: Common (Fig. 25).

Habitat: Mesic forest with permanent or temporary pools throughout Basin (Smith, 1961). Uncommon or absent in agricultural and suburban areas. Typical of boreal forest, northern mesic forest, northern lowland forest, southern lowland forest, southern mesic forest.

Reproduction: Breeds March through April. Eggs 2000 per female, deposited in submerged globular masses attached to plant stems (Minton, 1972). Hatching two to three weeks. Metamorphosis 6-15 weeks (Minton, 1972).

Diet: Terrestrial insects; various other arthropods (Minton, 1972).

Comments: Wood frogs are sensitive to forest clearing, disappearing completely in cleared areas. Minton (1972) reported that northern Indiana populations inhabit moist woods adjacent to swamps.



Fig. 24. Distribution of *Rana septentrionalis*.

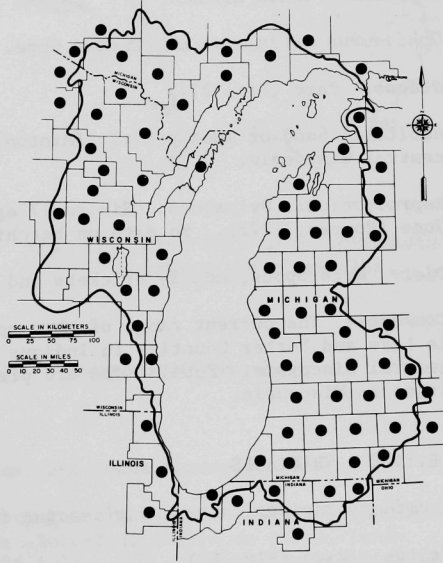


Fig. 25. Distribution of *Rana sylvatica*.

REPTILES OF THE REGION

SCINCIDAE - SKINKS

Eumeces fasciatus (Linnaeus). FIVE-LINED SKINK.

Status: Common (Fig. 26).

Habitat: Inhabits forest edge areas. Pine barrens, oak savanna, northern mesic (xeric hardwood) forest in Wisconsin. Frequents decaying logs, dead trees, abandoned buildings (Smith, 1961).

Reproduction: Oviparous (lays eggs which develop outside the female's body). Eggs laid mid-June. Nest cavities under or within rotting logs. Clutch size 5-12 eggs (Minton, 1972). Incubation 40-45 days. Sexual maturity 1-1/2 years after hatching (Fitch, 1954).

Diet: Variety of arthropods; crickets, grasshoppers, spiders most common (Fitch, 1954; Minton, 1972).

Comments: Female skinks brood the eggs during the incubation period. This activity is advantageous in that the eggs are protected from predators; are kept moist, in part from urination by the female; and, as a result of frequent rotations by the female, are freed from fungal attack (Porter, 1972).

ANGUIDAE - GLASS LIZARDS

Ophisaurus attenuatus attenuatus Cope. WESTERN SLENDER GLASS LIZARD.

Status: Rare (Fig. 27).

Habitat: Sand or muck prairie (Minton, 1972); oak savanna, pine barrens in central Wisconsin.

Reproduction: Oviparous. Six to 17 eggs laid under logs, rocks, etc. in mid-June (Porter, 1972). No data on hatching or age to maturity.

Diet: Arthropods, mostly crickets and grasshoppers; reptilian and bird eggs.

Comments: The current range of this species in the Basin is probably limited to Lake and Porter Counties in Indiana and the oak savanna and pine barrens of central Wisconsin. Populations are presently quite low at older, known localities in Wisconsin.

TEIIDAE - WHIPTAILS

Cnemidophorus sexlineatus sexlineatus (Linnaeus). SIX-LINED RACERUNNER.

Status: Rare (Fig. 28).

Habitat: Shrub, cottonwood, and pine seral (ecological successional) stages of Indiana Dunes State Park.

Reproduction: Oviparous. Eggs laid mid-June; hatching mid-August (Minton, 1972). Three to five eggs per clutch deposited under bark or other solid objects (Fitch, 1958).

Diet: Arthropods; predominantly insects.

Comments: Racers are known to inhabit rodent burrows and mole runways. They are active at higher ambient and substrate temperatures than other lizard species of the Basin.

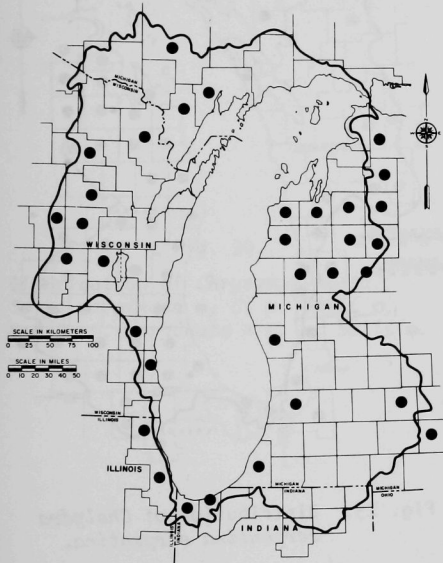


Fig. 26. Distribution of *Eumeces fasciatus*.

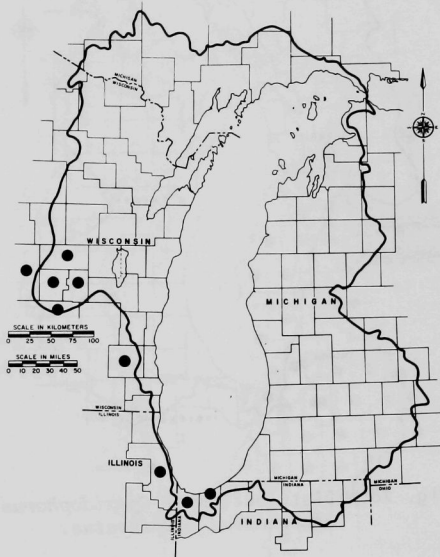


Fig. 27. Distribution of *Ophisaurus attenuatus attenuatus*.

CHELYDRIDAE - SNAPPING TURTLES

Chelydra serpentina serpentina (Linnaeus). COMMON SNAPPING TURTLE.

Status: Abundant (Fig. 29).

Habitat: Inhabits lakes, rivers, streams, and ponds throughout Basin.

Reproduction: Mating occurs any time during active season. Nesting predominantly in May and June. Eggs (20-93 per clutch) deposited on loose, sandy soil near water [normally within 15 m (50 ft)]. Two clutches per season laid by some females (Minton, 1972).

Diet: Fish, aquatic plants, carrion, aquatic invertebrates (Minton, 1972).

Comments: The common snapping turtle is the turtle of greatest economic importance in the Basin due to its use as food. As a result it has been extirpated in some areas of Wisconsin. The young of late summer clutches may not emerge from the nest chambers until spring (Minton, 1972). Snapping turtles often nest in muskrat lodges (Mathiak, 1966).

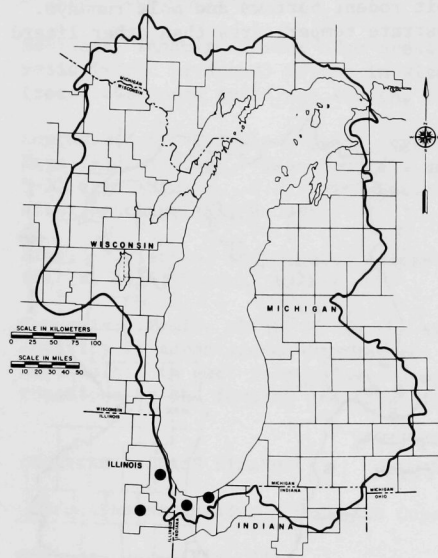


Fig. 28. Distribution of *Chrysemys sexlineatus sexlineatus*.

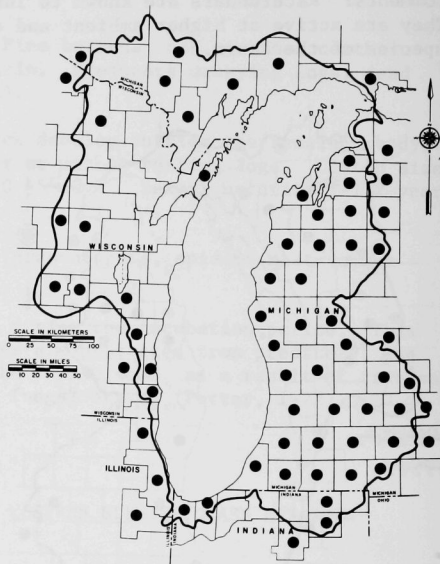


Fig. 29. Distribution of *Chelydra serpentina serpentina*.

EMYDIDAE - BOX AND WATER TURTLES

Chrysemys picta (Schneider). PAINTED TURTLE.

Status: Abundant (Fig. 30).

Habitat: In Indiana, quiet, shallow bodies of water with soft bottoms and macrophyte beds (Minton, 1972). All water body types in Wisconsin; fast-moving clean rivers, lakes, marshes, farm ponds, polluted rivers.

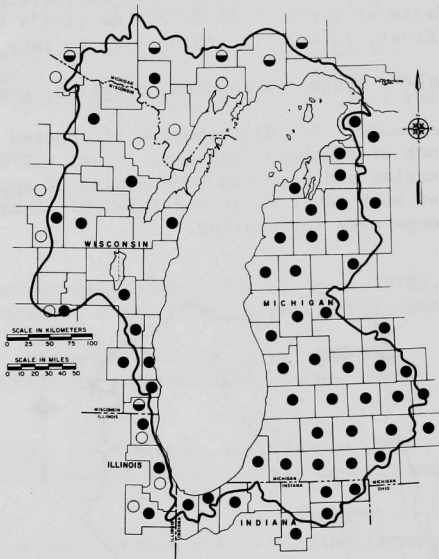
Reproduction: Mating soon after spring emergence from hibernation. Eggs (4-10 per clutch) deposited in loose soil, May or June. Hatching September (Minton, 1972; Smith, 1961). Emergence from nest chamber often not until spring. Sexual maturity reached at 1-7 years (Porter, 1972).

Diet: Evenly divided between plant and animal matter. Snails, aquatic insects (Minton, 1972). Earthworms, fish remains, aquatic vegetation (mainly duckweed), emergent marsh plants (Gibbons, 1967).

Comments: Two subspecies of the painted turtle (*Chrysemys picta marginata*, midland painted turtle, and *Chrysemys picta belli*, western painted turtle) (Fig. 30) are found within the Basin. Hensley (1975--personal communication) indicated that most populations in Michigan's Upper Peninsula represent intergrades between *C. p. belli* and *C. p. marginata* (Fig. 30). Moll (1973) reported that 61% of the females from two northern Wisconsin populations (Ashland and Bayfield counties) produced two egg clutches per year. Gibbons (1967) showed a strong correlation between food type and abundance and adult growth rates in three different populations in Kalamazoo County, Michigan. Growth rates were greatest in individuals feeding primarily on animal matter.

Fig. 30.

Distribution of *Chrysemys picta*.
C. p. marginata ●, *C. p. belli* ○,
 and *C. p. marginata* × *C. p. belli* ⊗.



Chrysemys scripta elegans (Wied). RED-EARED TURTLE.

Status: Rare (Fig. 31).

Habitat: Quiet water of marshes or ponds. Seldom leaves water. Basks on logs in water or on masses of floating vegetation (Conant, 1975).

Reproduction: Mating in spring. Eggs (5-22) laid on land in loose soil in late June or July. Nest sites within a few hundred feet of water (Minton, 1972). Hatching in September (Smith, 1961). Sexual maturity 2-5 years for males, 3-8 years for females (Porter, 1972).

Comments: The record from Muskegon County, Michigan, represents an introduction of the species into Michigan (Hensley, 1975--personal communication).

Clemmys guttata (Schneider). SPOTTED TURTLE.

Status: Rare (Fig. 32).

Habitat: Quiet, shallow waters with marsh vegetation adjacent to meadows in Indiana (Minton, 1972). Marsh, wet meadows, bogs, swamps, small ponds (Conant, 1975).

Reproduction: Mating soon after spring emergence. In northern Indiana, mating from mid-April to early May (Minton, 1972). One to four eggs laid during June. No data on nesting in Basin. Nesting habitat for Pennsylvania populations is loamy soil in well-drained areas along marsh (Ernst, 1970a). Nests at depth of 45.0-58.7 mm (1-3/4 to 2-5/16 in.). Incubation 70-83 days (Ernst, 1970a). Hatching mid- to late September.

Diet: Frogs, earthworms, crayfish, grass (Minton, 1972).

Comments: The distribution of spotted turtles appears to be discontinuous in much of southern Michigan. Ernst (1970b) studied a population of spotted turtles and reported home ranges of approximately 0.5 hectares (1.3 acres) for both adult males and females. Females usually migrated from the home range area for nesting.

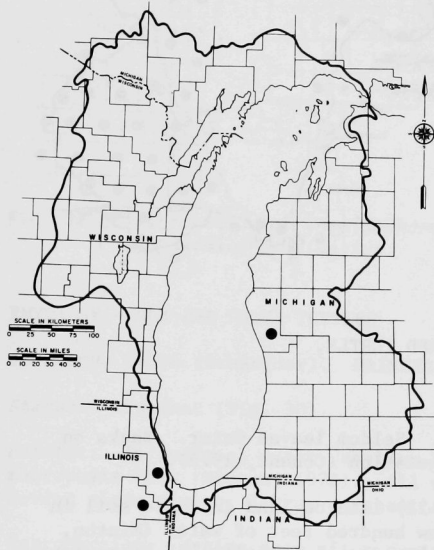


Fig. 31. Distribution of *Chrysemys scripta elegans*.

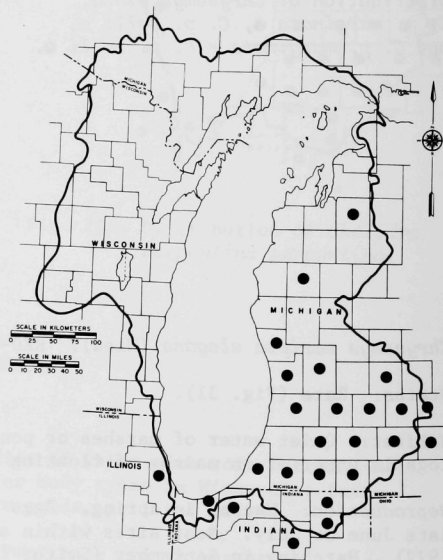


Fig. 32. Distribution of *Clemmys guttata*.

Clemmys insculpta (LeConte). WOOD TURTLE.

Status: Rare (Fig. 33).

Habitat: Meadows, old fields, often far from water (Conant, 1975). In Wisconsin, also along rivers in northern mesic forest, southern lowland forest.

Reproduction: Mating early June. Eggs (8-16) deposited on sand bars in late June. Hatching late August.

Diet: Largely herbivorous (filamentous algae, leaves of willows, grasses, sedges). Also caddisfly larvae, beetles, other arthropods (Lagler, 1943).

Comments: In Wisconsin, individuals tend to be much more aquatic than are members of eastern U. S. populations. With the exception of the gopher tortoises and box turtles, the wood turtle is the most terrestrial turtle of the U. S. (Conant, 1975).

Emydoidea blandingi (Holbrook). BLANDING'S TURTLE.

Status: Common (Fig. 34).

Habitat: Shallow, quiet water surrounded by marsh vegetation (Minton, 1972). Ponds in sedge meadows, wet prairies, marshes, small lakes, rivers in Wisconsin.

Reproduction: Mating fall (October) or spring (May). Six to 11 eggs per clutch laid in June (Minton, 1972). Hatchlings observed late August, early September (Minton, 1972).

Diet: Crustaceans, insects (Minton, 1972). In Michigan, crustaceans (50%), insects (25%); remainder consists of miscellaneous invertebrates, aquatic and terrestrial plants.

Comments: The Blanding's turtle spends a considerable amount of time foraging in marshes and sedge meadows adjacent to ponds. Gibbons (1968) studied a population at Sherriff's Marsh in Kalamazoo County, Michigan, and reported that females are represented in greater numbers on land than are males, during June. Both sexes were found on land during April and September between adjacent water bodies. Gibbons (1968) reported a population of 561 individuals over 100 mm (3-7/8 in.) in plastron length in 36 hectares (90 acres) of marsh and open water.

Graptemys geographica (LeSueur). MAP TURTLE.

Status: Common (Fig. 35).

Habitat: Rivers, streams with slow current and soft bottoms. Also in stream-fed lakes. Usually absent from creeks and ponds (Minton, 1972).

Reproduction: Mating April and May. Eggs (10-16 per clutch) laid in loose soil or sand near water in June. Hatching late July and August (Smith, 1961).

Diet: Mollusks (clams and snails), fish, crayfish, carrion (Minton, 1972; Smith, 1961). Aquatic insect larvae.

Comments: The map turtle apparently is slow to enter hibernation; specimens have been taken in November in Illinois (Smith, 1961). This species comes on land only when seeking a nest site. It is normally found only in areas of good water quality (Minton, 1972).

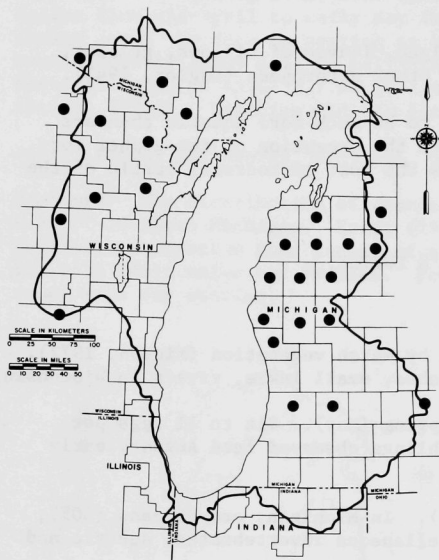


Fig. 33. Distribution of *Clemmys insculpta*.

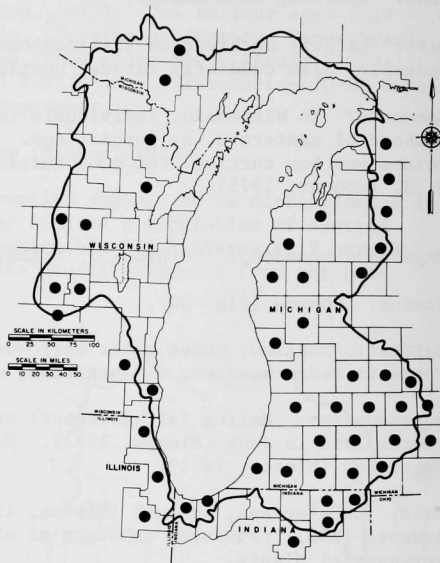


Fig. 34. Distribution of *Emydoidea blandingi*.

Terrapene carolina carolina (Linnaeus). EASTERN BOX TURTLE.

Status: Common (Fig. 36).

Habitat: Moderately well-drained woodland (Minton, 1972). Often among tree roots, along logs and stumps, or dense vines in summer (Minton, 1972). Southern mesic forest, northern mesic forest.

Reproduction: Spring and possibly fall mating. Three to eight eggs deposited in cup-shaped cavity in loose soil during late June (Minton, 1972). Hatching in September. Sexual maturity in 5-10 years (Minton, 1972).

Diet: Slugs, earthworms, beetles, berries, melons. Evenly divided between plant and animal matter (Minton, 1972).

Comments: The eastern box turtle is most active in April and May. Later in the summer it is usually seen only after rains or congregated around hillside springs. The population density of box turtles in a forest in Parke County, Indiana, was 8.9 per hectare (3.6 per acre) with individuals having a home-range diameter of 107-122 m (350 to 400 ft) (Minton, 1972).

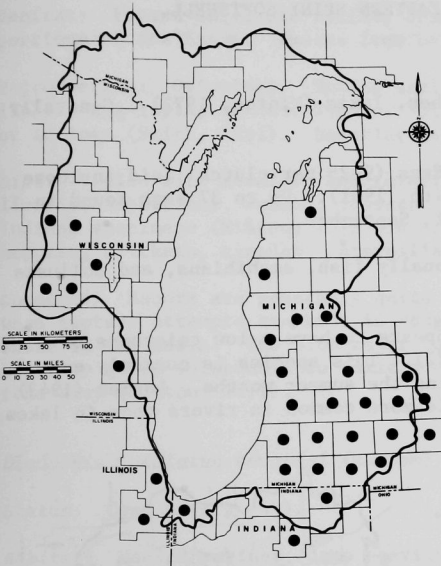


Fig. 35. Distribution of *Graptemys geographica*.

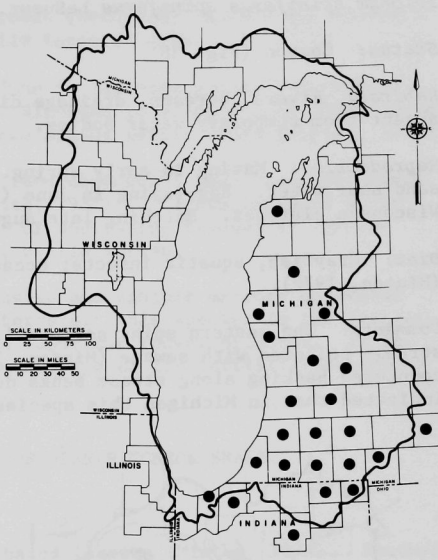


Fig. 36. Distribution of *Terrapene carolina carolina*.

KINOSTERNIDAE - MUSK AND MUD TURTLES

Sternotherus odoratus (Latreille). STINKPOT.

Status: Common (Fig. 37).

Habitat: Preference for permanent water with mud bottom; rivers, lakes, spring-fed ponds.

Reproduction: Mating both in spring and fall. Eggs (3-5 per clutch) laid during June, in wet soil several yards from water (Smith, 1961). Hatching in September.

Diet: Aquatic insects, carrion, mollusks (Minton, 1972; Lagler, 1943).

Comments: The stinkpot seldom ventures far from water. Its habit of sitting in muddy waters rather than basking makes it difficult to detect. It can

tolerate highly turbid and polluted waters; consequently it has persisted in urban and agricultural areas.

TRIONYCHIDAE - SOFTSHELL TURTLES

Trionyx spiniferus spiniferus LeSueur. EASTERN SPINY SOFTSHELL.

Status: Common (Fig. 38).

Habitat: Rivers, streams, drainage ditches, lakes (Minton, 1972). Generally absent from temporary water bodies.

Reproduction: Mating in early spring. Eggs (9-25 per clutch) laid in loose sand near water. Egg-laying in June (Smith, 1961). Up to 37 eggs found in Wisconsin clutches. Hatching late August, September.

Diet: Crayfish, aquatic insects; occasionally fish, amphibians, and mollusks (Minton, 1972).

Comments: The eastern spiny softshell appears to have a low tolerance of streams polluted with sewage (Minton, 1972). This species is commonly encountered basking along stream banks during the summer months. Lagler (1943) indicated that in Michigan this species is more common in rivers than in lakes.

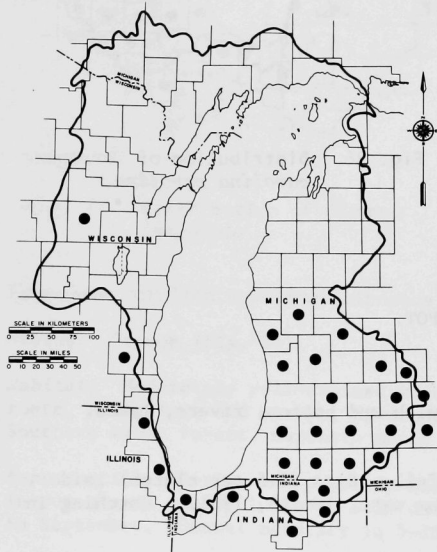


Fig. 37. Distribution of *Sternotherus odoratus*.

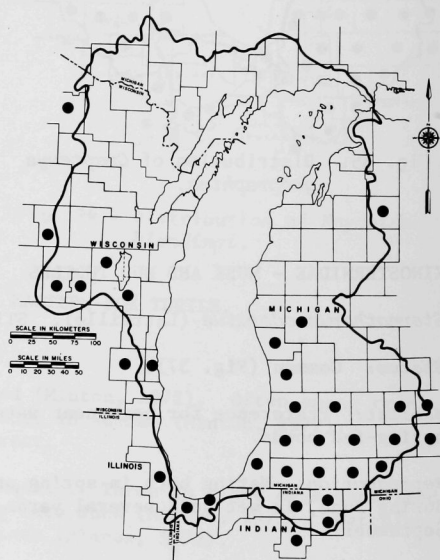


Fig. 38. Distribution of *Trionyx spiniferus spiniferus*.

COLUBRIDAE - COLUBRIDS

Coluber constrictor foxi Say. BLUE RACER.

Status: Common (Fig. 39).

Habitat: Forest-edge, old fields, open woods throughout eastern and southern portions of the Basin. Absent from heavily forested areas.

Reproduction: Oviparous. Mating early June in Illinois populations (Smith, 1961). Egg-laying in late June or July. Nineteen to 25 eggs laid under rocks or in logs (Smith, 1961). Hatching in late August within Basin (Minton, 1972).

Diet: Varies with locality and relative food abundance; small rodents, birds, lizards, amphibians, snakes, insects (Smith, 1961). Insects consumed by 14 Indiana specimens (Minton, 1972) in order of decreasing frequency: grasshoppers, crickets, cicadas, caterpillars, beetle larvae.

Comments: Racers are generally quite elusive and exhibit extreme quickness when capture attempts are made in rough terrain. This species is the fastest snake in the Basin. The blue racer is an important rodent predator. It is possibly quite vulnerable to toxic pesticides due to its partially insectivorous diet (Minton, 1972).

Diadophis punctatus edwardsi (Merrem). NORTHERN RINGNECK SNAKE.

Status: Common (Fig. 40).

Habitat: Wooded ravines, damp heavily shaded forests (Minton, 1972). Southern mesic forest, northern mesic forest.

Reproduction: Oviparous. One to six eggs per clutch laid under rocks or logs. Eggs laid late June. Hatching late August or early September (Minton, 1972).

Diet: Salamanders, earthworms, arthropods (Minton, 1972; Smith, 1961).

Comments: The northern ringneck snake is absent from prairie areas within the Basin and throughout the species range. There is some evidence to suggest that this species is a communal egg-layer (Blanchard, 1942). Ringneck snakes are primarily fossorial during the active season and consequently often go unobserved in areas where they may be abundant.

Elaphe obsoleta obsoleta (Say). BLACK RAT SNAKE.

Status: Common (Fig. 41).

Habitat: Forested areas. Southern mesic forest, northern mesic forest.

Reproduction: Oviparous. Mating occurs in May. Fifteen to 20 eggs per clutch. Eggs laid in rotting logs, stumps, or soil (Minton, 1972). Hatching in September.

Diet: Mammals and birds (both adults and eggs).

Comments: Within the Basin, the black rat snake occurs only in the southern half of Michigan's Lower Peninsula, Indiana, and Illinois. Remnant populations are frequently encountered in wooded areas around urban centers. This species disappears quickly from an area once forests are cleared (Minton, 1972). Black rat snakes are excellent climbers, often observed 4.6 to 6.1 m (15-20 ft) above ground vertically on tree trunks. In agricultural areas near forested areas, rat snakes are common around farm buildings.

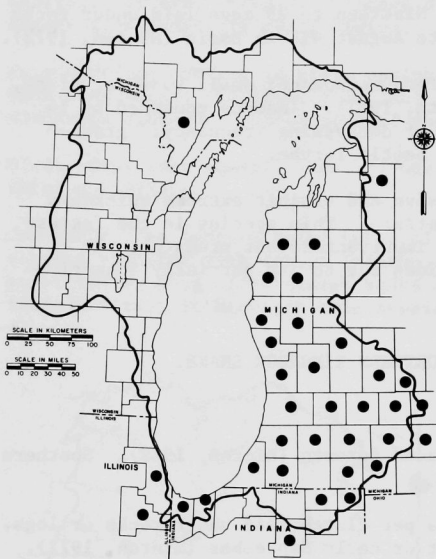


Fig. 39. Distribution of *Coluber constrictor foxi*.

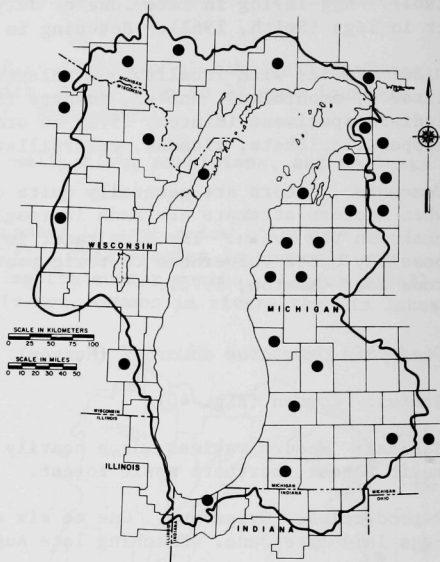


Fig. 40. Distribution of *Diadophis punctatus edwardsi*.

Elaphe vulpina vulpina (Baird and Gerard). WESTERN FOX SNAKE.

Status: Common (Fig. 42).

Habitat: Often in fence rows between agricultural fields in Illinois and Indiana (Minton, 1972; Smith, 1961). Inhabits old fields and oak savanna in central Wisconsin. Southern mesic forest, southern xeric forest, northern xeric forest.

Reproduction: Oviparous. Copulation in June. Egg-laying in late June. Clutches of 8-27 eggs buried in soil or under objects (Smith, 1961). Hatching in late August (Minton, 1972).

Diet: Birds and mammals (Minton, 1972; Smith, 1961). Voles (*Microtus ochrogaster* and *M. pennsylvanicus*) and white-footed mouse (*Peromyscus leucopus*) constitute bulk of diet (Minton, 1972).

Comments: The western fox snake is often mistaken for a copperhead due to its dull orange head. It is commonly referred to as a "pine snake" in central Wisconsin due to its local abundance in pine savannas. The eastern edge of the species range within the Basin corresponds closely with the prairie-forest ecotone in northwestern Indiana.

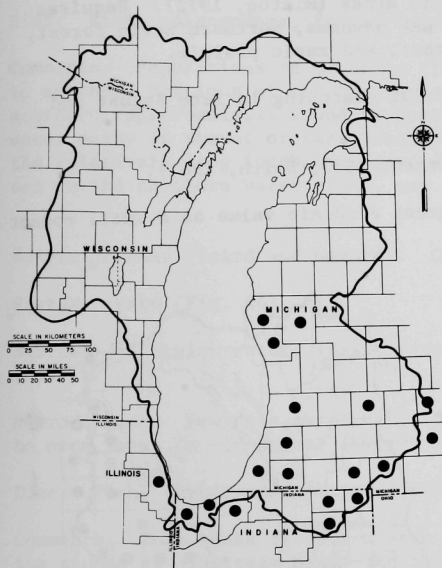


Fig. 41. Distribution of *Elaphe obsoleta obsoleta*.

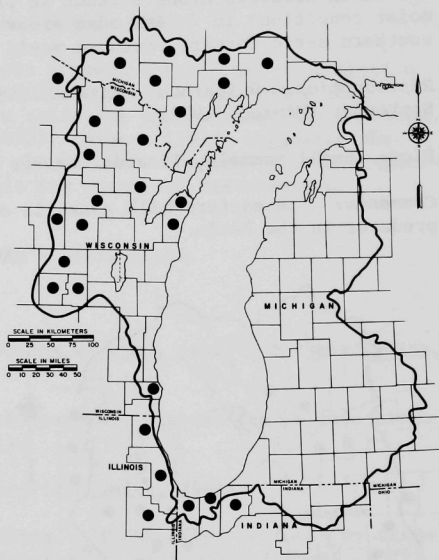


Fig. 42. Distribution of *Elaphe vulpina vulpina*.

Heterodon platyrhinos Latreille. EASTERN HOGNOSE SNAKE.

Status: Common (Fig. 43).

Habitat: Dry open areas; wet-mesic and xeric prairies, southern lowland forest.

Reproduction: Oviparous. Six to 27 eggs per clutch in captive Indiana specimens (Minton, 1972). Clutches of up to 38 eggs found late June in Wisconsin. Egg-laying late May, June. Hatching late August, early September.

Diet: Toads, frogs, salamanders (Edgren, 1955).

Comments: The eastern hognose snake is the only reptilian species in the Basin that preys primarily on adult toads. It has some mechanism for resisting the toxins produced by toad parotoid glands.

Lampropeltis triangulum triangulum (Lacepede). EASTERN MILK SNAKE.

Status: Common (Fig. 44).

Habitat: Dry wooded ravines, oak savanna, old fields throughout Basin. Common in woodlots along streams in prairie areas (Minton, 1972). Requires moist conditions in forest-edge areas of oak savanna, northern xeric forest, southern xeric forest, southern mesic forest, and xeric prairie.

Reproduction: Oviparous. Eggs laid in July. Hatching in late August and September (Minton, 1972).

Diet: Small mammals, lizards, snakes (Minton, 1972; Smith, 1961).

Comments: The eastern milk snake is of great economic value as a small rodent predator in the Basin.

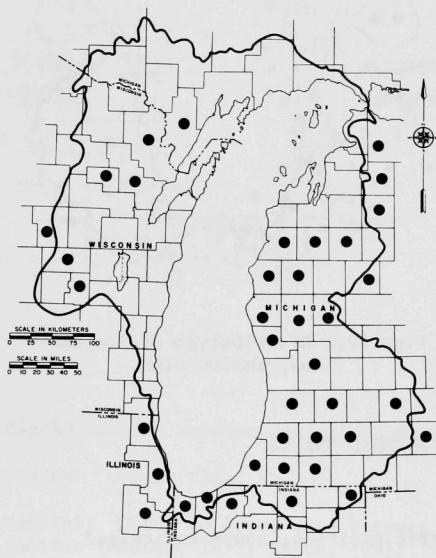


Fig. 43. Distribution of *Heterodon platyrhinos*.

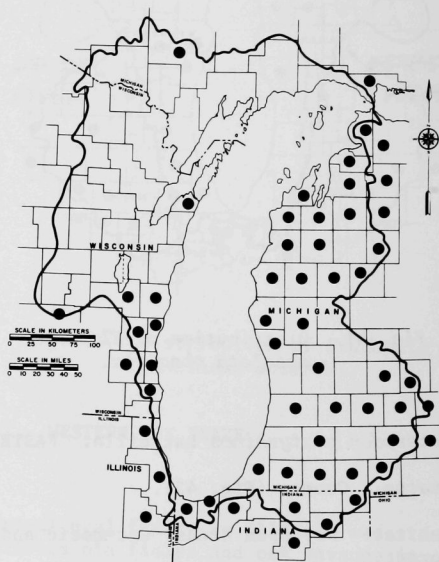


Fig. 44. Distribution of *Lampropeltis triangulum triangulum*.

Natrix erythrogaster neglecta Conant. NORTHERN COPPERBELLY.

Status: Rare (Fig. 45).

Habitat: Swamp forests in northeastern Indiana (Minton, 1972). Occurs around bogs in northeastern U. S. (Smith, 1961).

Reproduction: Ovoviviparous (give birth to live young which develop from a fertilized egg within the female's body). Mating late April, early May. Litters of 8-10 born late September (Minton, 1972).

Diet: Fish, salamanders, frogs, crayfish (Minton, 1972).

Comments: Populations in northern Illinois suggest a relictual distribution in northern portions of the species' range (Smith, 1961). Wherever the northern copperbelly is found in northern relictual populations, the northern water snake is absent or rare (Minton, 1972). Minton (1972) suggested that the relatively long incubation period of the northern copperbelly, in comparison to the northern water snake, may limit its northward distribution.

Natrix grahami (Baird and Gerard). GRAHAM'S WATER SNAKE.

Status: Rare (Fig. 46).

Habitat: Sluggish water; lakes, river-bottom sloughs, prairie marshes (Smith, 1961).

Reproduction: Few data available. Ovoviviparous. Captive female gave birth to nine young in mid-August (Smith, 1961).

Diet: Fish, amphibians, newly molted crayfish (Smith, 1961).

Comments: This snake is seldom seen basking. It can often be found by turning stones along stream banks and by examining crayfish holes (Conant, 1975).

Natrix kirtlandi (Kennicott). KIRTLAND'S WATER SNAKE.

Status: Rare (Fig. 47).

Habitat: Wooded ravines, drainage ditches, vacant lots (Smith, 1961).

Reproduction: Ovoviviparous. Mating mid-May. Four to 13 young born August, September (Smith, 1961).

Diet: Earthworms (Minton, 1972; Smith, 1961), slugs (Conant, 1975).

Comments: Urban or disturbed areas often contain established colonies (Conant, 1975; Minton, 1972). Although *N. kirtlandi* prefers a damp environment, it is not as aquatic as other water snakes.

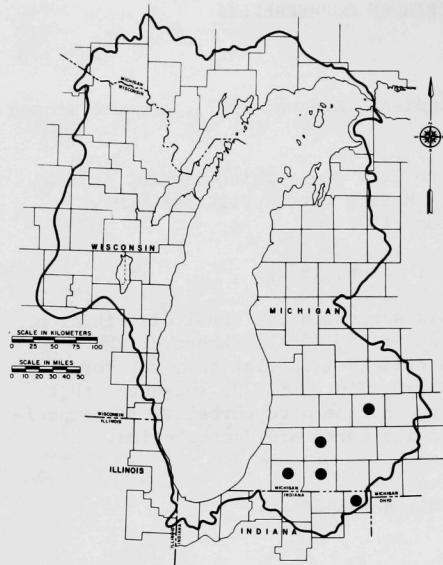


Fig. 45. Distribution of *Natrix erythrogaster neglecta*.

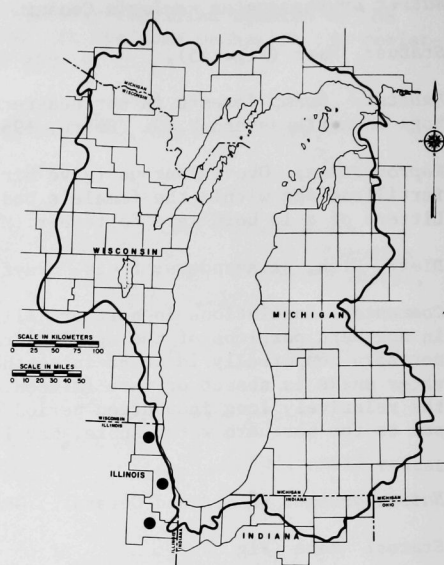


Fig. 46. Distribution of *Natrix grahami*.

Natrix septemvittata (Say). QUEEN SNAKE.

Status: Common (Fig. 48).

Habitat: Fast-flowing streams in forested regions. In Wisconsin, along spring-fed streams in southern lowland forest and shrub-carr communities.

Reproduction: Ovoviviparous. Mating in May. Young born late August, early September (Minton, 1972). Average litter size 11; sexual maturity attained in summer after third hibernation (Wood, 1949).

Diet: Almost entirely newly molted crayfish (Conant, 1975; Minton, 1972).

Comments: The queen snake is so uncommon in Wisconsin that it has been placed on the state's endangered species list (Wis. Dep. Nat. Resour. Endangered Species Comm., 1975).

Natrix sipedon sipedon (Linnaeus). NORTHERN WATER SNAKE.

Status: Abundant (Fig. 49).

Habitat: All types of aquatic communities ranging from bogs to rapidly flowing streams (Conant, 1975). Often in debris along lake or stream banks (Minton, 1972).

Reproduction: Ovoviviparous. Mating in May, after emergence from hibernation. Young born late August, early September. Ten to 40 young per female (Minton, 1972).

Diet: Opportunistic feeder; fish, adult salamanders and larvae, ranid frogs.

Comments: The northern water snake is probably found throughout the Basin. Throughout much of its range it is mistaken for a water moccasin and is considered extremely dangerous by the uninformed layman.

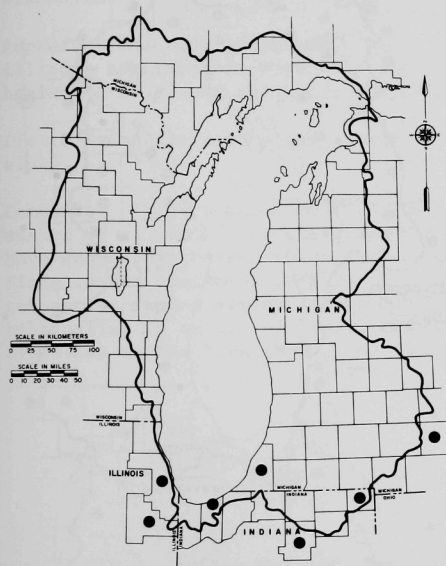


Fig. 47. Distribution of *Natrix kirtlandi*.

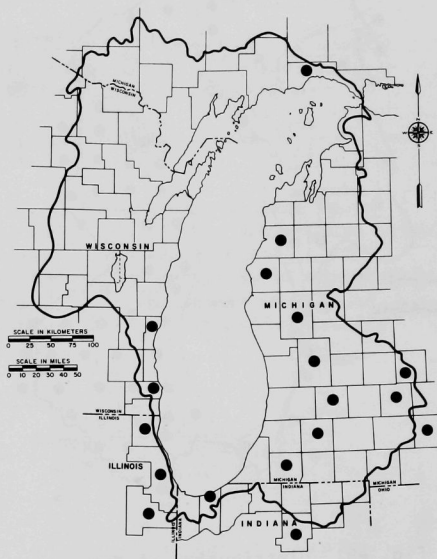


Fig. 48. Distribution of *Natrix septemvittata*.

Opheodrys vernalis (Harlan). SMOOTH GREEN SNAKE.

Status: Common (Fig. 50).

Habitat: Grassy openings. Typically oak savanna and pine barrens in Wisconsin.

Reproduction: Oviparous. Eggs laid under logs or rocks. Egg laying late June through July. Hatching late August.

Diet: Insectivorous; commonly grasshoppers, crickets, spiders, lepidopteran larvae (Minton, 1972).

Comments: In the Chicago area, Stille (1954b) reported nine nests from under rotting railroad cross ties. The occurrence of up to 15 eggs in some nests

suggests communal nesting. The junior author has discovered eight clutches, each with six eggs, in Wisconsin. Blanchard (1933a) reported an unusual four-day incubation period for specimens from northern Michigan. The insectivorous diet of this species makes it highly susceptible to the toxic effects of pesticides. The distribution of the two subspecies, *Opheodrys vernalis vernalis* (eastern smooth green snake) and *Opheodrys vernalis blanchardi* (western smooth green snake) is presented in Figure 50.

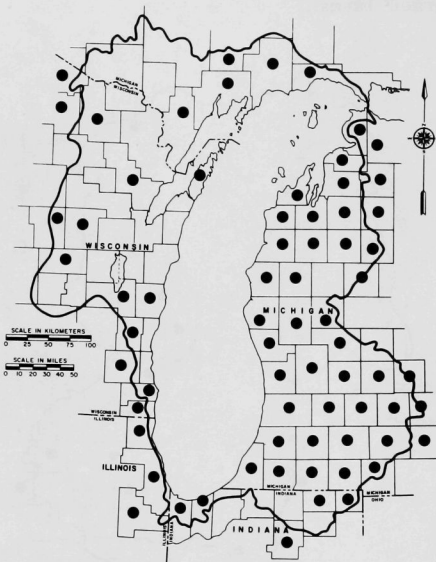


Fig. 49. Distribution of *Natrix sipedon sipedon*.

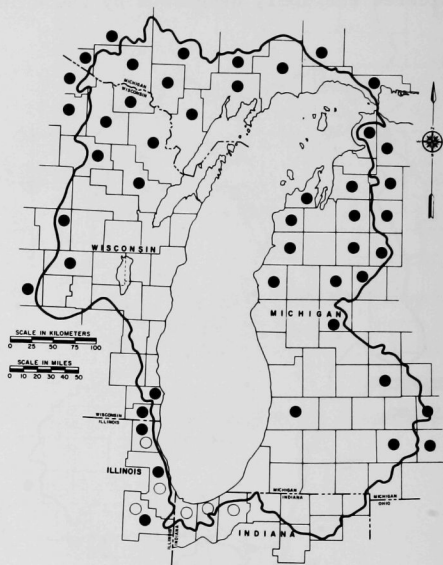


Fig. 50. Distribution of *Opheodrys vernalis*. *O. v. vernalis* ●, and *O. v. blanchardi* ○.

Pituophis melanoleucus sayi (Schlegel). BULLSNAKE.

Status: Common (Fig. 51).

Habitat: Open, grassy woodlots on dry sandy soils. Mesic and xeric prairies, bracken grassland, oak savanna, pine savanna in Wisconsin. Agricultural grain fields, old fields (Minton, 1972).

Reproduction: Oviparous. Mating late May. Egg-laying in June or July. Ten to 15 eggs per clutch laid under objects, in clumps of grass or burrows. Hatching in September (Minton, 1972).

Diet: Voles, deer mice, rabbits, ground squirrels, birds, bird eggs (Conant, 1975; Minton, 1972; Smith, 1961).

Comments: The bullsnake is quite valuable to farmers as a rodent predator. Bullsnares make a loud hissing sound and vibrate their tails when disturbed.

Storeria dekayi (Holbrook). BROWN SNAKE.

Status: Common (Fig. 52).

Habitat: Variable. Forests, old fields, rubbish-strewn city lots (Minton, 1972). Oak savanna, southern lowland forest, mesic prairie, forest-edge in Wisconsin.

Reproduction: Ovoviviparous. Five, 6, 12, 17 and 23 young born to captive Illinois specimens in late July and August (Smith, 1961). Sexually mature beginning of second spring following birth (Noble and Clausen, 1936).

Diet: Primarily earthworms (Smith, 1961); also sow bugs (*Porcellio* spp.) and slugs.

Comments: Three subspecies of *S. dekayi* (*S. d. wrightorum*, midland brown snake; *S. d. dekayi*, northern brown snake; and *S. d. texana*, Texas brown snake) have geographic ranges which include portions of the Basin (Conant, 1975). Since museum specimens were not all identified to subspecies level, geographic subspecies ranges are not depicted in Figure 41. Brown snakes were found hibernating in an ant hill with eastern garter snakes (*Thamnophis sirtalis sirtalis*) in New York (Noble and Clausen, 1936).

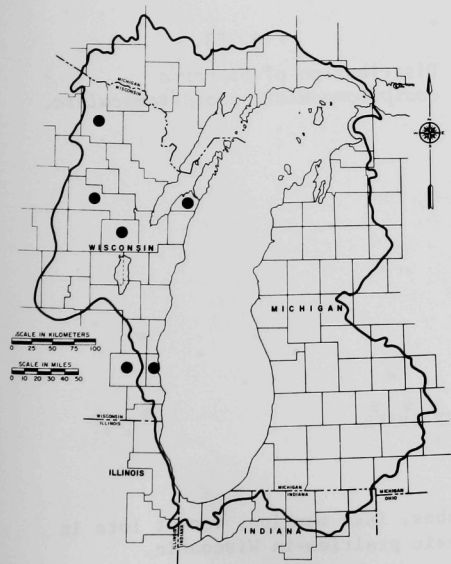


Fig. 51. Distribution of *Pituophis melanoleucus sayi*.

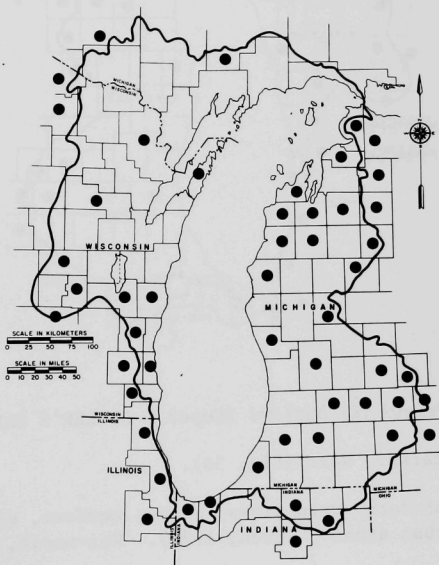


Fig. 52. Distribution of *Storeria dekayi*.

Storeria occipitomaculata occipitomaculata (Storer). NORTHERN RED-BELLIED SNAKE.

Status: Common, probably throughout Basin (Fig. 53).

Habitat: Wooded areas, occasionally wet meadows (Smith, 1961). Open woods around sphagnum bogs (Conant, 1975). Boreal, northern lowland, southern mesic, and southern lowland forests.

Reproduction: Ovoviviparous. Spring and fall mating. Young born late August. Sexual maturity end of first full active season (Blanchard, 1937).

Diet: Slugs, earthworms, other invertebrates (Minton, 1972).

Comments: Blanchard (1937) reported brood sizes of 4-13 (\bar{x} 7.18 \pm 2.54) from specimens in Emmett and Cheboygan counties, Michigan. Blanchard (1937) found evidence of spring and fall mating in northern Michigan populations.

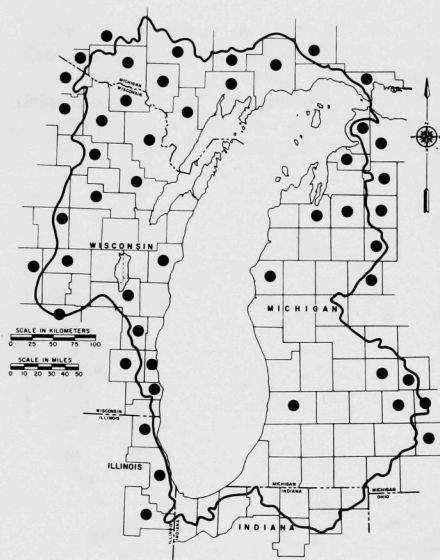


Fig. 53.
Distribution of *Storeria*
occipitomaculata occipitomaculata.

Thamnophis butleri (Cope). BUTLER'S GARTER SNAKE.

Status: Rare (Fig. 54).

Habitat: Open grassy areas; meadows, marshes, lake margins, vacant lots in urban areas (Minton, 1972). Wet-mesic, mesic prairies in Wisconsin.

Reproduction: Ovoviviparous. Mating in April. Young born July and August (Minton, 1972). Four to 19 young per litter (average 11). Sexually mature at end of first full season following birth (Carpenter, 1952).

Diet: Earthworms.

Comments: Butler's garter snake is on Wisconsin's List of Animals with Watch Status (Wis. Dep. Nat. Resour. Endangered Species Comm., 1975). This list includes vertebrates of probable changing status in localized populations. The habitat of this species is diminishing in the Milwaukee area due to urban sprawl.

Thamnophis proximus proximus (Say). WESTERN RIBBON SNAKE.

Status: Rare (Fig. 55).

Habitat: Semi-aquatic. In Wisconsin, along marshes and sandy areas of southern lowland forest adjacent to rivers.

Reproduction: Ovoviviparous. Mating in April. Eleven and 12 young born to Illinois and Indiana captive females in July and early August. Sexual maturity at beginning of second full active season following birth.

Diet: Fish, frogs (Smith, 1961; Minton, 1972).

Comments: The western ribbon snake is quite rare in occurrence over most of its range. Ribbon snakes are much more sensitive to habitat modification than other members of the genus *Thamnophis*. They disappear quickly when land is first cultivated (Minton, 1972).

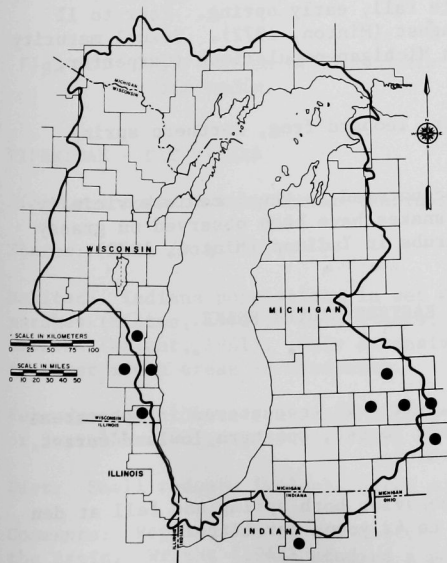


Fig. 54. Distribution of *Thamnophis butleri*.

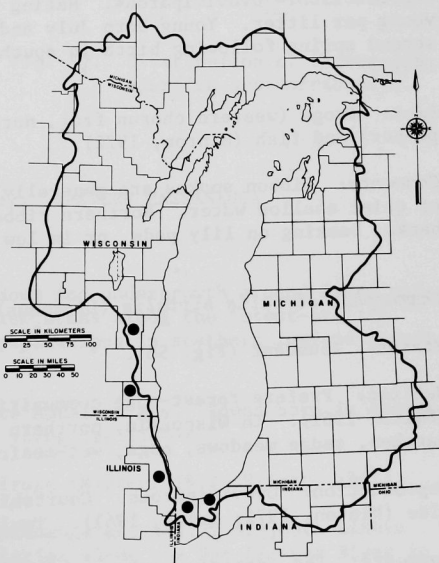


Fig. 55. Distribution of *Thamnophis proximus proximus*.

Thamnophis radix radix (Baird and Girard). EASTERN PLAINS GARTER SNAKE.

Status: Common (Fig. 56).

Habitat: Moist, open, grassy areas; mesic and xeric prairie, oak savanna in Wisconsin.

Reproduction: Ovoviviparous; broods ranging from 10 to 27 individuals born to females in the laboratory. Young born late August (Smith, 1961). Six to 40 young per brood in late August in Indiana (Minton, 1972).

Diet: Earthworms (Smith, 1961).

Comments: The eastern plains garter snake occurs within the Basin only in southeastern Wisconsin, Illinois, and northwestern Indiana (Fig. 56). This species at one time was quite common in vacant lots of cities but is now greatly reduced due to loss of habitat from urban sprawl.

Thamnophis sauritus septentrionalis (Rossman). NORTHERN RIBBON SNAKE.

Status: Rare (Fig. 57).

Habitat: Low, dense vegetation near shallow water. Sedge meadows, marshes, around lakes and ponds. Absent from forests (Minton, 1972). Found only around sphagnum bogs in Wisconsin.

Reproduction: Ovoviviparous. Mating late fall, early spring. Four to 11 young per litter. Young born July and August (Minton, 1972). Sexual maturity second spring following birth in southern Michigan populations (Carpenter, 1952).

Diet: Frogs (western chorus frog, northern leopard frog, northern spring peeper) and fish (Minton, 1972).

Comments: Ribbon snakes are generally encountered in the immediate vicinity of quiet shallow water. Northern ribbon snakes have been observed on grassy banks, basking on lily pads, or in low shrubs in Indiana (Minton, 1972).

Thamnophis sirtalis sirtalis (Linnaeus). EASTERN GARTER SNAKE.

Status: Abundant (Fig. 58).

Habitat: Prefers forest-edge communities, although encountered in open areas (Smith, 1961). In Wisconsin, northern mesic forest, southern lowland forest, marshes, sedge meadows, bogs, wet-mesic prairie.

Reproduction: Ovoviviparous. Courtship behavior both spring and fall at den site (Minton, 1972; Smith, 1961). Twelve to 42 young per litter.

Comments: The eastern garter snake is the most abundant garter snake species in the Basin, and probably occupies the widest variety of habitats. The subspecies *Thamnophis sirtalis semifasciata* (Chicago garter snake) (Fig. 58)

occurs in northwestern Indiana, northeastern Illinois, and southeastern Wisconsin. The ecological requirements of this subspecies are very similar to those of *T. s. sirtalis* (Smith, 1961).



Fig. 56. Distribution of *Thamnophis radix radix*.

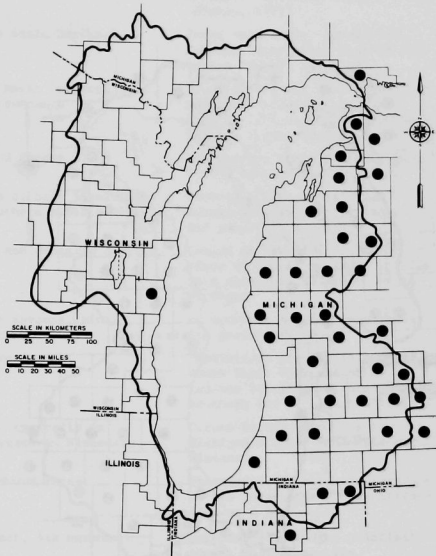


Fig. 57. Distribution of *Thamnophis sauritus septentrionalis*.

VIPERIDAE - PIT VIPERS

Sistrurus catenatus catenatus (Rafinesque). EASTERN MASSASAUGA.

Status: Rare (Fig. 59).

Habitat: Indiana populations in wet meadows and undergrowth around lakes and marshes (Minton, 1972). In Illinois, moist areas along the forest-prairie ecotone (Wright, 1941). Only extensive populations in southern lowland forest in river mouth areas in Wisconsin.

Reproduction: Ovoviviparous. Mating late April or May. Young born in August or September (Wright, 1941). Five to 14 young per litter.

Diet: Small rodents (voles), birds and frogs (Minton, 1972; Wright, 1941).

Comments: Populations of the eastern massasauga are mostly disjunct within the Basin. Wright (1941) studied a population along the Des Plaines River in northeastern Illinois (now in metropolitan Chicago). In 1969, the senior author observed a captive specimen taken from eastern Lake County, Illinois.

Housing developments and marsh drainage have led to the demise of this species in many areas of its range. Smith (1961) reported this species as common over the northern four-fifths of Illinois prior to intensive cultivation and drainage of marshes.

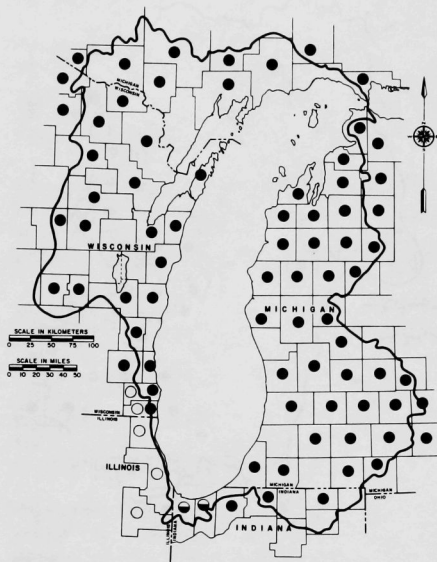


Fig. 58. Distribution of *Thamnophis sirtalis sirtalis* ●, *T. s. semifasciata* ○, and *T. s. sirtalis* × *T. s. semifasciata* ◐.

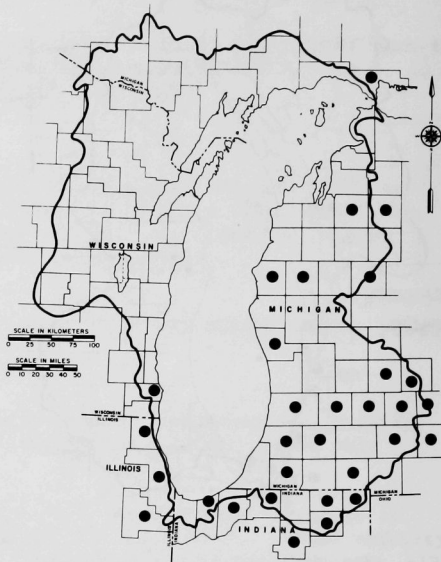


Fig. 59. Distribution of *Sistrurus catenatus catenatus*.

Table 2. Amphibians and Reptiles of Limited Distribution within the Lake Michigan Drainage Basin

Species	Habitat	Comments
<i>Ambystoma opacum</i> ¹	Southern lowland forest	Inhabits wooded dunes or hardwood forest in northern Indiana (Minton, 1972)
<i>Ambystoma platineum</i>	Near ponds in southern mesic hardwood forest	Found only in St. Joseph and Laporte counties in Indiana and Ingham County, Michigan
<i>Ambystoma texanum</i> ¹	Oak savanna, southern mesic hardwood forest, mesic prairie remnants	Found within the Basin in Hillsdale and Washtenaw counties, Michigan; northern edge of range in this region of the country
<i>Ambystoma tremblayi</i> ²	Southern mesic hardwood forest	Populations consist almost entirely of triploid females
<i>Hemidactylium scutatum</i> ³	Near spring-fed creeks or bogs in northern lowland forest and southern mesic forest	Commonly encountered under decaying logs; requires bogs and ponds for breeding
<i>Siren intermedia nettingi</i> ¹	Shallow lakes, ponds, and drainage ditches	Common in southern U. S. portions of range; wetland drainage is a threat to this species in Michigan
<i>Ophisaurus attenuatus attenuatus</i> ⁴	Dry-mesic prairie, oak savanna, pine barrens	An uncommon reptile throughout its geographic range
<i>Onemidophorus sexlineatus sexlineatus</i>	Dry-mesic prairie, lake dunes	Populations present in Indiana Dunes State Park and other Indiana localities around the southern end of Lake Michigan
<i>Clemmys insculpta</i> ^{3,5}	Northern mesic forest, typically in wooded areas along streams in Wisconsin	Occurs within the Basin in Michigan's Lower Peninsula and Wisconsin
<i>Terrapene carolina carolina</i> ¹	Oak savanna, open hardwood forest	Threatened, in northern portions of its range, due to its attraction as a pet
<i>Elaphe obsoleta obsoleta</i> ¹	Southern hardwood forest, oak savanna	Deforestation is the principal threat to this species
<i>Natrix erythrogaster neglecta</i> ¹	Swamp forest	Greatest threat is the senseless slaughter of this and other water snakes by man
<i>Natrix grahami</i>	Flooded lowland forest, lakes, prairie marshes (Smith, 1961)	Occurs in Basin only in north-eastern Illinois
<i>Natrix kirtlandi</i> ⁶	Old fields, vacant grass-covered lots commonly found in urban areas	Spotty in distribution throughout its geographic range
<i>Natrix septemvittata</i> ⁵	Along cold, rapid-flowing streams in southern lowland forest; also in shrub-carr communities in Wisconsin	Minton (1972) reported never having encountered this species along sluggish, muddy streams or in lakes or ponds
<i>Thamnophis butleri</i> ²	Wet-mesic prairie, old fields, vacant city lots	Locally abundant within city of Milwaukee
<i>Thamnophis proximus proximus</i>	Dry-mesic prairie	Found only in northeastern Illinois and southeastern Wisconsin. Suburban development in Lake and Cook counties (Illinois) has greatly reduced available habitat
<i>Thamnophis sauritus septentrionalis</i>	Southern lowland forest; bogs; often in forest-edge situations	Semi-aquatic around bogs, swamps, and lakes
<i>Sistrurus catenatus catenatus</i> ⁵	Southern lowland forest, mesic prairie, wet prairie	Once quite common in tall grass prairie of northern and central Illinois

¹Included in Michigan's List of Threatened Species.²Included in Wisconsin's List of Animals with Watch Status.³Included in Michigan's List of Species under Observation.⁴Included in Wisconsin's List of Threatened Animals.⁵Included in Wisconsin's List of Endangered Animals.⁶Included in Michigan's List of Endangered Species.References: Michigan^{1,3,6}, Tinkle and Hensley (1975); Wisconsin^{2,4,5}, Wisconsin Department of Natural Resources Endangered Species Committee (1975).

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